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VOL. CL., No. 2973.] TUESDAY, MAY 4, 1920. [72ND YEAR.

EDITORIAL NOTES.

Technical Programme for the Institution Meeting.

THE programme for the meeting of the Institution of Gas Engineers is now well advanced; and without any further attempt to extend it, there is good confidence on our part that there is a plenitude of technical fare for the profitable absorption of all the time that will be devoted to the sittings. An indication of the subjects is given in the minutes of the Council received from the Secretary (Mr. Walter T. Dunn) for publication in this issue. The very fact that Sir Dugald Clerk is the President—a President who has done service of incalculable value for the industry—is sufficient warranty for saying that the address to which the members will listen will be of a high order in both matter and quality. Then there are the reports of the Research Committees; and we are under the impression that, in view of the work that has been done at Uddingston, the report of the Gas Investigation Committee will possess an interest transcending that of the previous reports from the same source. There will also be the report of the Refractory Materials Committee; and as Dr. Mellor was seen by his last report to be better equipped for pressing forward with research, there will be good anticipation in this direction. The Committee on the Life of Gas-Meters, though not always confining themselves to this piece of apparatus, never fail to justify their existence by presenting something of practical value. Then there will be the report of the Institution Gas Research Fellow. If rumour is truthful, the Society of British Gas Industries will come along with a voluminous contribution on "Carbonization," illustrated by many drawings; but for the purpose of the meeting, a digest will be available. An old subject will be brought up in, we may expect, a new dress supplied by latter-day scientific investigation, by Prof. J. W. Cobb and Dr. Dufton. The title is "Oxygen in Gas Purification." Mr. J. Fisher will speak from personal knowledge, in a paper for which he has made himself responsible, of "Electricity Supply by Gas Com-"panies." This will present an opportunity to managers who have experience of both supplies to give the members the benefit of it. No title has yet been announced for a paper that will be contributed by Mr. G. Warburton. It is observed that Mr. George Helps was invited to make a contribution; but he has declined. Nevertheless, the programme strikes us as a good one, and sufficiently variegated. There may be some feeling of regret that matters of current political importance to the industry will not be before the meeting. But the next place for debate, in view of (as indicated in the "JOURNAL" last week) the early presentation of the Bill to deal with the heat-unit basis of charging and the redressing of the industry's financial grievances, will be in Parliament; and it will be recognized that at this juncture no good purpose would be served by having a free discussion at an open meeting of gas engineers.

Work of the Board of Fuel Research.

THE newly issued report of the Fuel Research Board is stated to be for the years 1918 and 1919. It is something more than that; it is a report without any time-limit. It is true that it portrays what has been done during the past two years; but it contains a programme of work that must take years to bring to fruition. It shows how vast and varied is the investigation that is before the Board; and so how immense and general has been the neglect of organized exploration in this country of the utilization of our fuel resources so as to obtain the maximum economy and efficiency from their use. For this neglect, a heavy penalty has been, and is being, paid in waste. We gave in last week's issue the part of the report dealing with the finished work of the Board—particularly of the enthusiastic Director of Fuel Research (Sir George Beilby, F.R.S.)—on Gas Standards, as well as the section describing the National Fuel Research Station at East Greenwich. In this station, valuable work will be done, and from it results of great importance to the country will be obtained. Notwithstanding that the Fuel Research Station is, for convenience in the disposal of products, on land belonging to the South Metropolitan Gas Company, and although Dr. Carpenter and his colleagues have given the Board every facility and assistance required, it should be pointed out very clearly that in no respect have the Chairman, Directors, or officials intruded upon the work of the Board, nor have they any intention of doing so. Sir George makes a special point of this; and we imagine that this is the reply to the questioning there has been in some quarters where suspicion resides as to the work of the Board not being perfectly independent, but subject to a certain amount of domination or supervision from the governing body of the South Metropolitan Company. Sir George's remarks dispose once and for all of this uncalled-for suspicion, about which we must say that it is not very encouraging to those who have undertaken responsible work of such national importance—which is to cover all fuel consumption both domestic and industrial, and all fuel-producing systems however operated—to have their independence assailed as has been the case here. But Sir George and his colleagues are above being affected, or diverted from their trust and aim, by petty thrusts of this kind (partly by men with axes to grind) when national efficiency and practical work and economy are calling for scientific aid.

Those who have read the descriptive account of the lay-out and present equipment of the Fuel Research Station will have come to the conclusion that it is a national possession for which it was well worth waiting a little time, so as to get everything into such order that research could be thoroughly carried out, and the results be received as definite and conclusive. The very character of the plant so far installed shows that carbonization in its more modern aspects is to be investigated with scrupulous care—coal carbonization in vertical retorts without and with steaming, and coal, coke, and peat gasification in producers. From the incoming coal to the outgoing products, there will be very careful weighing and analyses, testings of values, and records made; and for the performance of all this there has been every provision. The Board are out for refinement in accuracy, and for placing gas and bye-product methods in their correct position—not (there must be no misunderstanding) for the gas and coking industries' purposes only, but for all purposes. This is a quest for fuel economy and efficiency in all the ramifications of fuel use. The Board are starting out with a catholicity and impartiality which will make their findings all the more acceptable. High-temperature and low-temperature processes will receive even-handed justice. The claims and respective merits of coal, coke, coal gas, water gas, producer gas, and oil, for boiler firing and other industrial purposes will be explored with the freedom conferred by perfect disinterestedness, in which connection the virtues of two-stage carbonization—low temperature first for the recovery of the oils, and the residue of solid fuel submitted to higher temperatures for the making of producer gas with ammonia recovery—will

be investigated, mainly with a view of producing spirit for motor use and fuel oils for marine purposes. In this connection, pulverized coal and the production of fuel alcohol are to be the subject of research. Fuels for domestic purposes—in the smokeless form and as briquettes—will be manufactured and examined; the radiant efficiency of fuels and the reduction of atmospheric pollution will be considered; while, at the same time, the trend of preference for labour-saving fuels will not be overlooked, in conjunction with the proposals for the development of the gas supply industry on the heat-unit basis. The Board are obviously out not only for finding, and endeavouring to co-ordinate, the best lines for effecting an overall economy in fuel use and application, but simultaneously to make the country as free as is possible of the importation of motor spirit and fuel oils. All this will have to be subject to a proper survey being made of our coal resources, which the Board have also in hand; for it is pretty clear that we are at present dealing very prodigally with our bituminous classes of coal, of which it is notorious we have a smaller store than of more inferior coals. The work of the Board should have preceded and not succeeded the schemes of electrical development, because what is being done would have afforded considerable guidance in this direction. Even now, in the circumstances of the times (which must retard the rate of capital expenditure in carrying out mammoth schemes), the results may not come too late to have influence upon the course of future development. Speaking of electricity, it is seen that the research station is being equipped with a private generating plant—gas-engine driven—and we hope that detailed records of the working results, character of load, consumption for various purposes, &c., will be kept and published.

All this work of exploration will take time. Meanwhile, fuel waste continues. Is there nothing that can be done to diminish it? Sir George Beilby acknowledges the benefit of the work that is being done by the gas industry; and, looking into the future so far as is humanly possible, he sees great prospects of the industry, developing on the heat-unit basis, contributing largely to the economy of the country, by a greater production from the coal used of thermal value in the form of gas. He realizes that there will be a contra account in an accretion to distributing costs through the distribution of a lower grade gas. But we are not inclined to think it will be anything like an increase that will detract much from the gain, in manufacturing economy. Manufacturing economy for producing coal savings, and a lower price for the thermal value distributed by underground means to the consumer, are the main considerations. A large part of many gas distribution systems have a margin of distributing power under present pressures. Higher pressures will facilitate the distribution of larger volumes; and the more development of use tends to equalize the minimum and maximum load in winter, the greater the volume of gas that will pass through the mains. The gas industry must progress, or go under; and we can assure Sir George Beilby that its prospective distribution problems are not the most troublesome with which it has to contend.

However, the point under notice is that in the country generally there is great fuel waste. We cannot tell yet to what control of fuel use the revelations of the work of the Board will lead. Therefore, what can be done in the meantime? The Director of Fuel Research suggests that in the reduction of waste a beginning should be made with things as they exist. That is the best place of attack. And the users of fuel are the proper people to commence at once the good work of economizing it. There has been much inertia in this direction; and what has been still prevails. Sir George is of opinion that the high prices of fuel will stimulate the application by consumers—both domestic and industrial—of economizing methods. There is no doubt that it will; but perhaps not to the extent that he may imagine. Consumers are getting accustomed to high prices for all commodities; and the aim has been not so much to reduce the costs of commodities as to make income fit the higher outgoings for them. The pre-war quantitative standards of fuel consumption are largely the post-war ones; and if they are not exceeded, then the consumer simply puts down his additional costs to the higher prices paid. That is the difficulty; there the inertia. We do not say this is true universally; but the truth of it occupies an extensive field. We know in the gas industry through the adoption of our commodities and processes that, both in the household and in industry, economy is being sought; but this is far from being universal. Even with existing methods of fuel use, as Sir George truly says, there is gross waste which known methods could decrease largely. As the result of his study of this matter, he declares that in the majority of industrial undertakings a reduction of 5 to 20 p.ct. could be effected in the consumption of fuel at a relatively trifling expenditure; and he cites a case where a saving of 30 p.ct. was realized during the past year merely by the application of more perfect control. If throughout the country consumers set to work to effect fuel economy, the aggregate requirement for coal could very quickly be considerably diminished, and more so if the Coal Control Department would ensure the incombustible material in coal being lowered at the collieries to the pre-war level. What a field for national economy lies in that one direction!

Gas Standards and Honesty in the Industry.

Of the part of the report dealing with gas standards, we cannot say we are altogether pleased with the contents; while at the same time, knowing Sir George Beilby, we are quite prepared freely and fully to acknowledge that he and his colleagues had no intention to do an injustice to the gas industry as a whole. The stigma of a wrong action in one place, particularly when given circulation through an official document, is often utilized for wide application by some people; and we fear that this is what will unjustifiably happen through part of the statements contained in this section of the report. There is some satisfaction on the part of the Board, and this satisfaction is shared by the industry, that the proceedings on gas standards led to an agreement which has found such favourable acceptance, though the condition as to inerts may retard in many places, under the plant conditions, the fullest and earliest application of the liberty in producing the cheapest heat units for the consumers. The placing of the operations—manufacturing and trading—of the industry upon a heat-unit basis is regarded by the Board as a development which will be helpful in establishing more business-like relations between gas undertakings and their consumers; for it is very clear that the Board do not think much of the protection that was given to the consumers in the past by selling cubic feet of gas which had to, or were supposed to, comply with certain standards.

We wanted to have, and hitherto it has been regarded from this standpoint, the coming change in the gas industry's basis of operations developed as being economically expedient. But on this occasion, after reading the report, the feeling dominates that the idea has taken root in the mind of Sir George and his colleagues that the change is also desirable to prevent fraudulent practices on the part of gas undertakings. The report states that the Board have had before them "abundant evidence" that the present method of charge lends itself "too readily" to the "systematic" delivery of gas "much below" the stipulated calorific value, so that, though the consumer in "many cases" did not receive the thermal units to which he was entitled, he had to pay for the cubic feet which had passed through his meter. Now we say frankly and emphatically that we do not like this statement, nor the words quoted in it. We do not doubt the sincerity of Sir George and the other members of the Board; but the words are sweeping and besmirching. It would be instructive to know more about the "abundant evidence." Does it refer to the war period and these days of grave shortage in coal deliveries and quality? Or does it apply to pre-war days? If to pre-war days, then why, in the case of companies, did not the local authorities see that the stipulated calorific quality was supplied? In those days, in large part, the standard was, of course, not a calorific one, but an illuminating one.

There is more in the report which gives the idea that there have been in the statutory conditions big loopholes for fraudulent action in the gas industry in regard to the quality of the supply to consumers, and that gas undertakings have not been at all averse to taking advantage of them. We have not the slightest doubt that the Board do not wish it to be thought that they stamp the gas industry generally with dishonest practices. But the words unfortunately may be interpreted by some as having that effect. It is pointed out that the recognized methods of testing do not provide effective means for remedying the state of things to which there has been reference. Of course, this assertion is directed to the intermittent character of the qualitative tests,

and to the fact that notice of tests has to be given to the suppliers. As to the notice, it only applies to tests made for a penal result if, under the specified conditions, a deficiency is shown. Therefore, the conditions being prescribed by Parliament, and the apparatus used being mostly that specified by the Metropolitan Gas Referees, it was only right the gas suppliers should have an opportunity of being represented at the tests if they so desired. Gas examiners are not infallible; and the industry has not been immune from the results of error, misjudgment, and work perfunctorily performed. But the gas industry would be the last to suggest that because of this all gas examiners are as a class discredited. Nothing of the kind. Good reason, however, has existed, under the old conditions, for notice of tests being given, and an opportunity for representation being at least available. But in this very notice the Board see an opportunity for trickery on the part of gas suppliers, which opportunity should be eliminated. It would be quite pardonable for an outsider to infer from the line of argument in the report that trickery of the kind is almost a practice in the industry.

"The Board have had before them," we read, "clear evi- "dence in certain cases that only during the brief period of "the pre-arranged test was the gas up to the required stan- "dard, and that at all other times it was below the standard." "In certain cases." How will this be interpreted by outsiders, and probably by members of Parliament? It is in the plural; and therefore denotes more than one undertaking. The report only supplies a single instance of a condition of things that on the face looks like an act unscrupulous and deplorable. It is not specifically stated to which undertaking this refers. But the fact that a chart from a recording calorimeter was supplied to confirm the allegation by a Gas Consumers' Association, tells the whole gas industry as plainly as if the name was written to which undertaking reference is made. The chart shows that gas which had been running at approximately 440 to 450 B.Th.U. began to increase in value about two hours before the time of the official test until it reached a peak at 565 B.Th.U. (the result of the official test was 560 B.Th.U.), and then there was a tailing-off until once more about 450 B.Th.U. gas was reached. We should have been disposed to take this as a coincidence, and not as a deliberate act or a practice so far as that particular concern goes, were it not that the Board remark: "The wave of rich gas had evidently "reached the calorimeter of the gas examiner some little time "before it had reached the recording calorimeter; *for this "slight lag is similarly shown on all the monthly charts which have "been submitted to us.*" This we construe to mean that the same thing has been shown by the monthly charts from the recording calorimeter when compared with the results of the tests by the official examiner. If this is the incorrect meaning, then the publicity given to the chart would not be justified. The Board admit that the experience may be regarded as exceptional; but, taken in conjunction with the line of argument, what will be the effect of the publication by the Board of an "exceptional" experience upon the minds of men who do not understand these matters, and who readily grasp anything that will help to confirm an all too easy credence in habitual dishonesty being one of the characteristics of the gas industry?

However, the recording calorimeter will prevent even lapses from right-doing in isolated cases; and we are glad to see the Board's appreciation of the value of Simmance's total-heat recording calorimeter. They are also desirous of examining and testing any other calorimeters that may be invented. Every responsible gas official, too, should give heed to what the Board say as to educating gas consumers to appreciate the value of the B.Th.U. Their suggestions in this regard will be found on p. 190 of last week's issue of the "JOURNAL."

Finance of Housing-Scheme Gas Installations.

THERE has recently been a considerable amount of discussion as to the costs involved in gas installations under the new housing schemes; and figures which show great dissimilarity have been published. This is largely due to the differences in the ideas of the authorities and of gas suppliers as to the components of the gas scheme, and as to the part of the financial responsibility that should be taken by the authorities and the gas suppliers respectively. Some gas undertakings have several authorities to deal with in their supply areas; and these authorities again have diverse notions regarding what should be embraced in the schemes, and what they should pay. Some of them would like to escape all payment, and put the whole burden upon the gas undertakings, who, to put the matter plainly, cannot in these days of financial stress stand it; nor would it be (at the present levels of expenditure) a fair thing at any time for them to have the entire cost placed upon their shoulders. It has been demonstrated that a good saving can be effected in house building by the structural economies permitted by the utilization wherever possible or feasible of gas in place of solid fuel; and the improvements in the convenience of houses and in labour-saving and dirt are also matters of value. On these grounds, and that of the financial difficulties and disabilities the gas industry is suffering, it is essential that a substantial proportion of the cost of installing gas in the new dwellings should be borne by the promoters of the schemes; and gas undertakings must insist upon this, to check extravagant expenditure on their own part.

Every scheme, through the absence of standard conditions, has to be the subject of individual negotiation, and financial arrangement. As showing the diversity of schemes, preferences, and financial arrangements, we may here quote from some general particulars that we have by us. There is one very large scheme, the capital cost of which averages rather more than £19 per house; and of this the authorities concerned have arranged to pay something like 50 p.ct. The price is exclusive of mains; but the houses will be dependent entirely upon gas for lighting and cooking; and the gas suppliers will provide a prepayment meter, cooker, and fittings. In this instance, the provision of hot-water apparatus is under consideration; and, if anything is done in the matter, it will be the subject of a supplementary agreement. There is knowledge of several local authorities who have entered into agreements with gas suppliers for carcassing houses, and fixing hot-water apparatus—the authorities bearing the whole cost of this, with the exception of mains; leaving the question of meters, fittings, and cookers, for arrangement between the company and the tenants. This appears to us a much better arrangement than the one first mentioned. There is also before us an offer to local authorities to carcase houses at 6s. per point, providing that gas is the artificial illuminant; and this has been accepted by several authorities. This seems to us to be a low and highly tempting price, having regard to figures that have been previously quoted, and to which reference was made by "Distribution Engineer" in a letter appearing in the "JOURNAL" last week.

It is very satisfactory to see so many local authorities making provision for hot-water supply by gas-heated apparatus—circulator, cylinder, and pipes all complete. While out for modernization and for labour-saving, a few pounds more or less spent by the housing authorities will not matter much, providing there is (as in this case there will be) in the expenditure genuine value for the tenants. Speaking of heating water, we have only noticed one authority who are fixing a gas-boiler as an addition and alternative to a coal-range boiler. In this case, the hot-water installation is being carried out (the authority providing all the material) under the supervision of the local gas company, who upon the completion of the authority's work attaches the boiler. Where the housing authorities are doing the piping themselves, it is highly important that the gas suppliers should be on such terms with them that advice is accepted, and supervision is allowed and welcomed. It is to the interest of both parties that the work should be well done, and adequate to the demands that will be made upon the equipment. The cost of hot-water installations, of course, varies according to circumstances. But in a case in which a considerable experience is being gained, it is found that, in the majority of instances, the price is £19 15s. per installation. This includes the provision of a boiler and tank, running the cold supply from the cold-feed cistern (provided by the housing authority), and the running of the expansion-pipe, and all draw-offs from it. The position that gas is taking in the housing schemes is highly satisfactory. The chief point upon which gas suppliers must, however, insist is that the financial arrangements are of an equitable character.

Legislative Devolution and Private Bills.

A PERENNIAL question, and one which has often been the subject of ingenious (if not always practical) suggestions, is as to how to improve our legislative machinery, and to relieve Parliament of some of its more or less formal work. But nothing has ever come of the proposals, other than

the removal of Scottish local legislation to the care of the Scottish Office, with provision for local consideration, and in the case of Public Bills greater recourse to the assistance of Standing Committees after the Bills have had a second reading in the House. Another move is now being made; and information regarding the proposals is furnished by a special article by the Parliamentary Correspondent of the "Daily Telegraph." In June last year a resolution was passed by the House of Commons, which led to the setting-up in October of what is known as the Speaker's Conference to consider and report upon a scheme of legislative and administrative devolution within the United Kingdom (since limited to Great Britain). The resolution laid down various points to which the conference were to have regard—such as reserving to Imperial Parliament the exclusive consideration of Foreign and Imperial Affairs, and subjects affecting the United Kingdom as a whole, as well as the allocation of financial powers as between Imperial Parliament and the subordinate legislatures. As a result of the conference, two schemes are to be laid before the Government—one proposed by the Speaker, and the other a modification by Mr. Murray Macdonald. The Speaker's scheme is transitional in character. It is suggested that a practical trial should be given, by responsible persons with political experience, to subordinate legislative bodies—one each for England, Scotland, and Wales (including Monmouthshire). The idea of a transitional period is good, as, in such a matter as this, permanency should be based upon experience. So it is proposed that the transitional period should consist of three years, with a further period of two years, during which the subordinate legislatures must consider their future constitution, and a final period of a year during which the schemes devised must be submitted to Parliament. It is proposed that the subordinate legislatures shall be named Grand Councils, and each area is to possess two chambers—one constituted of selected members of the House of Commons for the area, the others of members of the House of Lords. It is suggested that the spring and summer months should be reserved for the ordinary sessions of Parliament and the autumn for the ordinary sessions of the Grand Councils; and that the Palace of Westminster should be placed at the disposal of the latter bodies for the purpose of holding their sessions.

The interest of our readers in this matter is due to the changes that it would, if adopted, bring about in parliamentary procedure affecting Private Bills; for among the many local matters which it is proposed should be entrusted to the Grand Councils are the Private Bills of gas, water, and electricity undertakings. Legislation appertaining to electricity undertakings has only lately been placed in the hands of the Electricity Commissioners, for the express purpose of co-ordinating the provision and supply of electrical energy; so that it is hardly likely electricity would now be transferred to the Grand Councils. In regard to Gas and Water Bills, we do not see that the Grand Councils would be any improvement on present procedure, unless, when the full details of the scheme are published, it is found that provision is contemplated for regional inquiries to save expense; and then we are faced by the difficulty that Parliamentary Agents and Consultants are largely located in London—mostly at Westminster. There is, however, the suggestion that the principle of the Scottish Private Bill procedure should be extended so as to be made applicable to English and Welsh Private Bill legislation. Under the Scottish procedure, the inquiries into Private Bills are held in Scotland, which is a convenience. But if this is to be changed for Scotland, and English and Welsh promoters are to be brought to Westminster, and the proceedings be all pressed into an autumn session, we doubt whether any advantage will accrue to them in relieving the heavy expense now entailed. The only gain would be the relief of the Imperial Parliament; while promoters are also entitled to relief. The question of the reduction of the expense of Private Bill procedure has often been discussed. One way in which costs could be curtailed in the case of gas undertakings would be by the General Acts referring to them being brought up to date; for the bulkiness of Bills session after session (due to the repetition of numerous clauses that are now common to all Gas Bills) assists greatly to increase costs, while, with the General Acts modernized, their adoption might be simply by reference. While on this point it is a pity that sets of protective clauses with county, urban, and railway authorities could not be agreed upon; for there again is room for economy.

Gas Workers' Pay and Hours.

So far as we have been able to gather, there is no change in the position in respect of the demands of the National Federation of General Workers and the *non possumus* attitude of the employers. It simply comes to this that, in the condition of the industry with regard to finance, it cannot shoulder further burdens in the way of shorter hours and higher pay—more especially with the prospect at hand of still heavier coal prices. It is understood that a statement of the case from the employers' side is being prepared for publication, and that it will give live facts and figures relating to the financial situation of the industry. Meanwhile all the Unions in the Federation of General Workers have signified their assent to a ballot being taken of the gas workers throughout the country. It is proposed that the papers shall be returnable by May 18; and that, if the voting is in favour of a strike, the necessary notices will then be given. It is intended to give sufficient length of notice so that gas making shall, if possible, cease throughout the country on the same day. That is the idea. Meanwhile, the hope is still alive that there may be a reopening of negotiations, and a peaceful solution be found. There is no desire on our part to minimize a critical position; but we are hoping the ballot of the men will show a preponderance of votes in favour of good sense.

Statutory Companies and the Corporation Tax.

A correspondent tells us we were in error, when writing on the subject of the Budget last week, in assuming that no definite pronouncement had been made as to the application of the corporation tax to statutory companies. He asks us to turn to the official report of the proceedings in the House on the 20th ult., as there it would be found that the Chancellor of the Exchequer, in reply to Sir John Butcher, said the tax did apply to railway and other statutory companies. This we find is what took place. Sir John asked: "Is it intended to apply only to companies known as limited liability companies, or is it intended to apply, as the words of the resolution seem to imply, to such companies as railway companies and other statutory undertakings?" The reply of Mr. Chamberlain was: "Yes, to railway companies." That is apparently the nearest approach yet made to clearing-away the indecision that still exists on this matter. If railway companies, it seems that it is proposed to include other statutory companies. However, our correspondent says the strongest argument that can be put forward by the gas industry for exemption from the tax is to be found in the small amounts that may be set aside to renewal and insurance funds, &c. The sums appear ludicrously small compared with the numerous bonus distributions that have been made, in the form of shares, by limited liability companies in other trading spheres during the last few years. Like submissions were made by Mr. F. A. Gulland, of Maidstone, in the letter published in our "Correspondence" columns last week.

Return on Capital.

It was recently shown in the "Journal" that the London County Council are proposing to raise objections to the financial proposals in the South Metropolitan and South Suburban Gas Bills, which are now due to come before the Committee of the House of Lords to which they have been referred. Of course, the Council may not get the chance to be heard, if it is decided that this section of the Bills, and that dealing with the heat-unit basis of charging, shall be deferred until the Government measure has been disposed of. If, however, witnesses from the County Council are put into the chair, it will be highly interesting to inquire of them as to the current ideas of the public regarding dividend and interest, as illustrated by the meagre manner in which the public were attracted by the Council's 5¾ p.ct. loan, the greater portion of which was left in the hands of the underwriters. The terms of the new Government bonds for reducing the floating debt are also symptomatic of changed public views. In addition to the minimum of 5 p.ct., these bonds will up to May, 1925, receive an extra rate of interest when the average rate of discount on Treasury bills for the six months preceding May 1, or Nov. 1, exceeds 5½ p.ct. When the Treasury bill rate exceeds 5½ p.ct. up to 6½ p.ct., an additional 1 p.ct. per annum will be paid. When the average discount rate is 6½ p.ct. or upwards, the additional rate of interest will be 2 p.ct. per annum. Thus if the discount rate on Treasury bills remains at 6½ p.ct. (as it is now) for the next six months, the first interest payment on Nov. 1 will be at

3½ p.ct.—that is at the minimum rate of 5 p.ct., *plus* the addition at the rate of 2 p.ct. per annum, or together 7 p.ct. These are remunerative terms for an investment with the State behind it.

High-Pressure Gas Distribution and Leakage.

It is claimed that the largest high-pressure gas-distribution system in this country is that at Grays, about which the Engineer (Mr. A. W. Sumner) read a paper at the meeting of the Eastern Counties Gas Managers' Association a fortnight ago. It will be seen that he has brought a demand upon his works from a considerable expanse of country. One point that he made in the course of his reply to the discussion is that, though his unaccounted-for gas is about 10 p.ct., quite half of this is due to meter defects, which is a fairly common condition at the present time in the industry, through the circumstances produced by the war. The remaining 5 p.ct. only averages out to 8 c.ft. per hour per mile of main. This is a new mode of calculating and expressing leakage; and it is a modest amount, considering the extent of the rural area dealt with. On the Company's 100 miles of main. the leakage averages 800 c.ft. per hour; and multiplying this by the 8760 hours in a year, the loss is 7 millions, which is very modest. Even if Mr. Sumner is a bit out in his calculation as to the loss due to meter defects, the actual leakage, in his circumstances, would not be regarded as a serious matter.

War Time Gas Enlightenment.

Had it not been for the war, the gas industry would have missed much rapid development in its processes and methods. We should not have known so much as we do now, from actual experiences, as to gas quality and gas mixtures; and we should not have been taking such an active interest in the building of houses and their gas equipment as is now the case, had it not been for the incentive offered by another product of war time—the housing schemes. What has been learnt is all to the good; and from the store of new knowledge, developments are coming apace. These are points that impress one as the evidence is read of Dr. E. W. Smith, Dr. Leonard Hill, and Mr. R. J. Rogers before the Smoke Abatement Committee. Prior to the war there was a firm belief that such or such a standard of heating value for gas ought not to be passed in the downward direction. The war has taught us to be cautious over this matter, to curb dogmatic assertion, and always to leave an opening for escape whatever opinion is expressed in this regard. Dr. Smith told the Committee [*ante* p. 212] that the consumer, with present-day gas appliances and provision for adjustment, is not placed under any disadvantage with 450 B.Th.U. gas, providing the B.Th.U. are supplied at the same price as the B.Th.U. in a (per cubic foot) higher grade of gas. There are other men, with large practical experience during the war, who speak equally confidently of 400 to 420 B.Th.U. gas. He also gave the Committee information as to the various systems the gas industry possesses for making gas of lower calorific quality per cubic foot. A point of interest is his confirmation of other investigators' views that gas produced by complete gasification is better than blue water gas for admixture with a richer coal gas, owing to the greater harmony of composition. But he, like others, is looking for a complete gasification system that will give, in addition to gas, a return in tar oils and ammonia. It is quite evident that Lord Newton was much impressed by what Dr. Smith had to say as to the want of sympathy with the gas industry on the part of the Government during the war, while they themselves made considerable demands upon the industry.

Synthetic Ammonia.

The sale to Messrs. Brunner, Mond, and Co. has been sanctioned of the partially-built Government factory at Billingham-on-Tees, for the extraction of nitrogen from the air. The purchase price has not been disclosed; but it is estimated that the capital required to complete and work the factory will be £5,000,000. It is stated that the new Syndicate propose to establish the fixation of atmospheric nitrogen on an extensive scale, and the plans, both of the ammonia and the nitric acid sections, will embody a number of important improvements on existing practice. The money already spent on the works, and the suggested capital, make the extensiveness of the operations perfectly obvious. Of the Bellingham plant it is said that it will represent a substantial advance on anything previously used in Germany; and this is [precisely what is said of the Georges Claude process, which the Cumberland Coal, Power, and Chemicals Company Ltd., are adopting on a large scale. The first unit of this synthetic ammonia plant to be installed in Cumberland will, it is stated, be of sufficient size to permit of the production of 50,000 tons of sulphate of ammonia per annum. In this French process compression of the nitrogen and hydrogen is effected in a single operation at 1000 atmospheres, instead of the lengthy chain of operations in the Haber process at 200 atmospheres, which pres sure has to be constantly maintained and restored at each step.

PERSONAL.

There was a large gathering on the 24th ult. of members of the staff and Fittings Department of the Birmingham Corporation Gas Department, when a presentation was made to Mr. WILLIAM BATT, JUN. (District Inspector, Fittings Department), who has been appointed Chief Distributing Superintendent to the Stoke-on-Trent gas undertaking. In the unavoidable absence of the General Manager and Secretary (Mr. A. W. Smith), the Fittings Superintendent (Mr. R. J. Rogers) presided. Since he came to the department in 1908, Mr. Batt had, said Mr. Rogers, proved his worth. His chiefs had always been able to rely on him; and the men who worked for him had had confidence in him. On behalf of the many subscribers in the Fittings Department, he wished Mr. Batt all success in his new appointment, and asked him to accept, as an expression of the esteem in which they held him, a mahogany combined music and china cabinet. Mr. Batt expressed his thanks to the many subscribers for their gift, which he and the members of his family would always treasure.

Sir HENRY BIRCHENOUGH has been appointed Chairman of the British Dyes Corporation in place of Lord Moulton, who has, "The Times" understands, resigned owing to pressure of judicial work. Sir Henry Birchenough is a Director of the Continental Union Gas Company and of the Imperial Continental Gas Association.

Among the associate members of the Institution of Civil Engineers whose elections were reported at the meeting last Tuesday, was Mr. LEONARD LACEY, B.Sc. (Eng.).

Lieut.-Col. ALAN STEIN, who is a Director of Messrs. John G. Stein and Co., of Bonnybridge, has been married in Edinburgh to Miss Maisie Mackellar. Lieut.-Col. Stein had a distinguished record of service during the war. He was decorated by the King with the Military Cross and Bar, was several times mentioned in despatches, and was wounded on three occasions.

Consequent upon the death of Mr. F. A. Price in December last, the Manchester Corporation Gas Committee have appointed Mr. FREDERIC P. SMITH to the position of Financial Controller, and Mr. GODFREY W. KAYE to that of Secretary of the Gas Department.

OBITUARY.

Mr. ANDREW GIBB, who has died at Belfast, in his ninetieth year, was for over twenty years Manager of the Newry Gas-Works, a position which he vacated in October, 1902. Since his superannuation, Mr. Gibb had lived in retirement; but he continued to manifest great interest in all that concerned gas affairs. He was a man of exceptional knowledge and judgment; and his long period of control in Newry was marked by many improvements and developments. The deceased was a native of the Armagh district.

The spring general meeting of the Midland Association of Gas Engineers and Managers will be held at Banbury next Tuesday week, the 18th inst.

Prof. Wm. A. Bone, D.Sc., Ph.D., F.R.S., will submit a contribution to the Indian and Colonial Sections of the Royal Society of Arts on Friday, the 28th inst.; the subject being "Lignite."

The Ministry of Munitions announce that Lord Inverforth has now sanctioned the sale of the Government nitrate factory at Billingham, Stockton-on-Tees, to Messrs. Brunner, Mond, and Co. The purchasers will form a company to take over and operate the factory, which was begun early in 1918, with a view to supplementing the country's munition resources, and was designed to manufacture synthetic ammonia from the nitrogen of the air and for the production of ammonium nitrate on a large scale. Constructional work was stopped after the armistice. The purchasers undertake to complete the scheme by providing the additional buildings and plant required for the manufacture of synthetic ammonia, and for its oxidation to nitric acid and nitrates, suitable for the production of explosives and of fertilizers. It is understood that the new company intend to develop the factory on a very large scale, and that the designs, both of the ammonia and nitric acid sections, will embody a great number of important improvements on existing practice. These have been developed from the results of the research work carried out at the laboratory founded in 1916 by the Nitrogen Products Committee; and in many directions the plant will represent a substantial advance on anything previously used in Germany.

INSTITUTION OF GAS ENGINEERS.

Council Meeting.

A meeting of the Council was held at the offices of the Institution last Thursday afternoon—Mr. Thomas Goulden (Senior Vice-President) presiding, in the unavoidable absence of the President (Sir Dugald Clerk).

Programme of the Annual General Meeting.

The programme of the annual general meeting, to take place on June 1, 2, and 3, was arranged. It includes the address by the President, the annual report of the Council, reports of the Research Committees (Gas Investigation, Refractory Materials, and Life of Gas-Meters); report of the Institution Gas Research Fellow; and the following papers: "Carbonization," by members of the Society of British Gas Industries; "Oxygen in Gas Production," by Prof. John W. Cobb and Dr. Dufton; "Electricity Supply by Gas Companies," by Mr. Joseph Fisher; and one by Mr. G. Warburton.

Mr. George Helps was invited to contribute a paper, but expressed himself as being unable to do so.

City and Guilds of London Examiners.

It was reported that, on the nomination of the Council of the Institution, the Committee of the Department of Technology of the City and Guilds of London Institute had appointed Mr. H. Kendrick, of Stretford, Examiner in "Gas Supply," and Mr. R. J. Rogers, of Birmingham, Examiner in "Gas-fitting"—beginning with the examinations of 1921. The Council nominated Mr. S. Tagg, of Preston, as Examiner in "Gas Engineering."

Civil Engineers (Registration) Bill.

The report was given of a deputation from the Institution which had met a Committee of the Council of the Institution of Civil Engineers with reference to the proposed Civil Engineers (Registration) Bill. Objections to the measure as at present drafted had been communicated and discussed. The Bill is in process of amendment; and it is understood that it cannot be dealt with during the present session of Parliament.

Demobilization Committee.

The Demobilization Committee reported on their work during the past year. The Council expressed their acknowledgments of the efforts of Mr. R. G. Shadbolt, who had acted as Chairman during the whole time the Committee had been in existence. Their thanks to the Technical Press for valuable assistance so kindly given was also heartily expressed.

Heating and Ventilating Research.

Mr. A. E. Broadberry reported on a conference arranged by the Institution of Heating and Ventilating Engineers, which he had attended as representative of the Institution—the object of the conference being to consider the question of the extension of the research work at University College, and the raising of a sum of £10,000 which would be required for it. It was agreed that the Institution would be willing to co-operate in the scheme of research proposed.

British Association Fuel Economy Committee.

The report of the representative of the Institution on the British Association Fuel Economy Committee (Mr. Douglas H. Helps) was presented. Its principal work has consisted of the presentation of a report to the British Association, and the sending of a deputation to the President of the Board of Trade. The Committee have selected for investigation the following seven subjects: (1) Thermal efficiencies of furnaces, heating apparatus, power generation, carbonization methods, and the like. (2) Low-temperature carbonization. (3) To review critically the present official methods of arriving at statistics relating to output of coal per worker employed in British mines, compared with those in America and Germany. (4) The question of the effect of the war upon the coal export trade. (5) Factory fuel consumptions, organization of power production, &c. (6) Methods of sampling coal on a large scale. (7) Relative fuel values of coal, oil, and pulverized coal.

Recording Gas-Calorimeters Committee.

It was announced that the Recording Gas-Calorimeters Committee had made arrangements for carrying out their investigations, in which the Research Sub-Commitee of the Gas Investigation Committee were co-operating.

Personal Matters.

The resignation of Dr. E. W. Smith from the Gas Investigation Committee and the Research Sub-Committee was accepted, with expressions of cordial appreciation of the services that he has rendered.

The Institution's congratulations were extended to the following members, on their appointment to the Order of the British Empire, in recognition of their services in connection with the war: Dr. Charles Carpenter, Mr. Thomas Glover, of Norwich, and Capt. H. Riall Sankey, C.B. (Commanders); Mr. J. H. Canning, Mr. E. V. Evans, Mr. Alex. Wilson, Mr. Charles Wood, and Mr. John Young (Officers); and Mr. William Wilson, of Burton-on-Trent (Member).

The deaths of the following were announced; and the sympathy of the Institution was expressed with those who had been bereaved: Mr. John T. Jolliffe, of Ipswich; Mr. James Lowe, of Plymouth; and Mr. Alpin MacGregor, of Llandudno.

There was a lengthy list of candidates for the next ballot, and several notifications of transfers and of admissions as students.

It was reported that Mr. E. H. Hudson, of Normanton, had been elected District Member of Council to represent the Manchester District Institution of Gas Engineers, and Mr. James R. Duff, of Banbury, to represent the Midland Association of Gas Engineers and Managers, for the year 1920 21.

ELECTRICITY SUPPLY MEMORANDA.

The Housing Committee of the London County Council have made arrangements with the Brentford Gas Company for the supply of gas to the houses to be erected on the Roehampton Estate, and for the necessary installation in connection therewith, subject to the Council contributing £10 towards the initial cost. For the work and equipment that will be involved, the £10 will not go far. It is a big and a leading job; and our electrical friends will be interested in the announcement. Meanwhile, they are still discussing what should and should not be done in connection with housing schemes; and the dreamers are dreaming beautiful dreams. These will not do much harm so long as they are confined to paper. We are pleased, however, to see that there is a growing appreciation in the electrical proposals that certain considerations, which were formerly given the go-by, have really something in them. We see at last recognition of the fact that, in a comparatively small house where supervision of children cannot be of the same high order as in houses where nurses and a governess are kept, and where the general environment is far from being the same, regard must be had to safety and to preventing misuse of the wiring, &c. For a long time, although attention has been called to it more than once in the "Memoranda," the point was totally ignored. Now we see that Mr. Alan Kirk, in an article in the "Electrician," puts the point at the very forefront that electrical men must accept as a governing factor "the reality of children and children's ways in adopting a scheme of wiring." He lays down as guiding principles in all electrical schemes for artizans' dwellings that there must be safety from shock and fire, low initial cost of materials and labour, and long life with low maintenance. The second condition sandwiched in between the two others is important; but if the first and third are to be realized, the second will be difficult of fulfilment. However, Mr. Kirk, humane and far-seeing, submits that, to eliminate all possibility of danger to life by means of electric shock or fire, it is necessary that all current-carrying parts must be covered or insulated with materials having a high insulation resistance; and these, in turn, must be protected with a strong mechanical covering. Very correctly, too, he holds that all current-carrying parts must be placed in such a position that they can neither be disturbed nor touched. That is very good; but we do not see much scope for securing a "low initial cost of materials and labour" by the utilization of Mr. Kirk's recipe. All this amounts to is that the designer should eschew the use of every highly manufactured and proprietary article, decrease the amount of highly skilled labour, and, by careful planning, restrict the quantity of materials required. If electrical work has been done properly in the past, then there is not room for much economy by following Mr. Kirk's advice. To secure long life, materials must be selected that will not quickly deteriorate; and they should be placed in positions where they are not likely to suffer from outside influences.

Safety First.

Extra Value Worth the Higher Cost.

That is all very good so far as it goes. Then Mr. Kirk proceeds to show that the difference between the cost of the best system and those that do not approach it in safety and reliability is not so very great, while the value obtained from the extra payment far exceeds the extra cost. He takes as an illustration a seven-room house; and the actual net cost of wiring for nine points, controlled by nine switch-points, exclusive of all fittings and accessories, he presents as follows: Cleated wire in roof for first-floor points and under first-floor flooring for ground-floor points: Materials, £2 3s. 8d.; labour, £3 15s. 7d.—total, £5 19s. 2d., or 13s. 3d. per point. Casing and capping on surface: Materials, £2 10s. 10d.; labour, £5 8s. 8d.—total, £7 19s. 6d., or 18s. 9d. per point. Stannos on surface: Materials, £2 7s. 11d.; labour, £3 15s. 11d.—total, £6 3s. 10d., or 13s. 9d. per point. Twin lead system on surface: Materials, £2 6s. 10d.; labour, £3 13s. 11d.—total, £6 0s. 2d., or 13s. 5d. per point. Screwed steel conduit buried: Materials, £2 10s. 5d.; labour, £4 15s. 10d.—total, £7 6s. 3d., or 16s. 3d. per point. Mr. Kirk's view is that, although the cost of the screwed conduit system is higher than the cleated, the additional advantages obtained, together with the high safety factor, fully compensate for the "slight" extra first cost, which, if taken as a percentage on the cost of the building and equipping of the whole house, in his opinion, is only an infinitesimal amount.

Unprofitable Business.

In the same issue of our contemporary, Mr. James Cleary, of Brighton, with whom we have had a little discussion in times past, treats of the "Electrical Equipment of Artizans' Dwellings" from quite another point of view. But

he also introduces other matters, which show that the wild rush of electrical people to get all the scraps of business they can has not altogether proved profitable. We are inclined to think that the time will come when much the same thing will be said of many of the installations in workmen's dwellings. Mr. Cleary has some inflated views as to what the artizan can be induced to do and spend in order to obtain electrical operation. He believes that, "if the nettle be grasped" [what a bad metaphor to apply to the business!], it is possible to discriminate in fixing a tariff for small residences which will overcome all the anomalies of the past, making this otherwise precarious business a fruitful source of certain profit. But he thinks that safeguards must at the outset be introduced to eliminate the bugbears of the past, the chief of which has been the "minimum charge" consumer, "who would have been better named the 'minus profit' consumer." If our recollection serves us rightly, Mr. Cleary has never in all his writings suggested that the electrical people had been so foolish as to take on business on non-profitable terms, nor has he ever, to the best of our knowledge, hinted that the supply to small-class property on the charge conditions prevailing was unremunerative. Then why the present change in his ideas? Regarding the minimum charge, he now says that "where it has been enforced, and where the charge has been for current consumed only—in such places as garages, studios, lock-up shops, rack-rented flats, and similar places—the cost of collection has often been more than the revenue obtained, to say nothing of the capital locked-up in meters, services, fuse-boards, &c., the increased cost of which, with the labour of fixing, must be saved in the future, and form one of the chief economies to be effected. This also applies to the prepayment meter, the cost and maintenance of which makes [*sic*] it prohibitive." Then another fault, which is common to all types of electric meters, is the great loss due to unregistered current by the use of small metal filament lamps. This loss is certain to become greater in the near future owing to the higher efficiency lamps. Mr. Cleary therefore considers that the time has now come for a tariff to be framed which will at least ensure payment for services rendered. Summer time again upsets the balance, which must be also adjusted. This change in summer time has transferred a considerable number of small consumers from the profit to the loss side of the sheet.

The Artizan's Equipment.

Credit must be given to Mr. Cleary for advocating a high standard of installation, if only from the point of view that, though the costs of installation are much increased, the reduced cost of maintenance will, in the long-run produce compensation. If the occupants of the new artizan dwellings have an opportunity of reading Mr. Cleary's article, they will be interested and amused; and some of them might even go so far as to express some rather pronounced views upon it. All restrictions, in his opinion, should be removed against the free use of any small current-consuming devices, "which should beneficially find a place in every home according to requirements." Probably they would; but they cost money, as any artizan could have found out who took the opportunity for visiting the Ideal Home Exhibition. Without extra wiring, says Mr. Cleary, a wide range of apparatus, not exceeding 500 watts, might be introduced into every house in the schemes under consideration—that is to say, into every artizan house erected under the schemes. It is interesting to see what is in this gentleman's mind for the artizan's house. Here it is: "The service should be available for the early morning cup of tea, shaving water, making toast, heating milk, making coffee, and later working a sewing-machine or for ironing, and the occasional use of a vacuum cleaner, a small grill or egg boiler, and many other labour-saving devices." The artizan and his wife will not know themselves under this electrical provision for their comfort. But they would have to buy these things, including a motor for the sewing-machine, an electric kettle, shaving-pot, toaster, saucepan, iron, vacuum cleaner, and so on, and will have to keep them in repair, if they do not tire of them and their behaviour. Perhaps the artizan may be told in confidence that, except for the working of the sewing-machine and the vacuum cleaner, he can do all these things cheaper and more promptly by the use of gas.

KW. Demand Tariff for the Working Man.

The working man—if he be honest and careful—likes to pay as he goes, and to be fairly sure he gets what he pays for. But as we understand Mr. Cleary, his intentions towards him are to put him on a KW. demand tariff; and so add to his confusion. We have seen that, in his opinion, the cost and maintenance of prepayment electric meters make them prohibitive; and in the part of the article proposing the application of a KW. demand tariff, he remarks that "the difficulty of obtaining meters, the cost of purchasing, the cost of labour for fixing, reading, recording, and maintaining of same, due to all-round increases, now necessitates an alternative method of charging, and one which will overcome all existing trouble will be welcome." Therefore this, together with the magnitude of the building schemes, justifies the adoption of a KW. demand tariff. The tariff, Mr. Cleary says, can be applied by a simple piece of apparatus, which is foolproof, robust, and reliable, is not affected by short-circuit, and is automatic in action. Where £8 to £10 per KW. cannot be offered, it should, in his view, be possible to fix a price within double that range in most districts. The advantages are these: The need for deposits to safeguard the amount would be avoided; and the risk of bad debts would be overcome by instituting a system of payment in advance monthly, or by including the amount due in the rent, and collecting it weekly. The cutting-out of the meter would, of course, reduce the cost of installation. Mr. Cleary proposes a further economy by linking-up groups of adjacent houses on a ring-system fed from both extremes; and, although as many as fifty cottages may be supplied through two services only, the chance of interruption of supply would be reduced to a minimum. Another advantage, it is submitted, is that the full capacity of the ring-main is always available for efficient use, whereas, with the separate service system, the reserve of conductor in the case of the small user, who is in by far the greater proportion, is wasted. Mr. Cleary is very much taken with this linking-up system, though it and his tariff proposal are not specifics for application in all phases of existing trouble. He puts them forward as suggestions to overcome the ill-effects of the high cost of materials and labour obtaining to-day. All this is from the electrical man's point of view; we are wondering what the artizan would think of the ideas—particularly the method of payment. As to this, the "Electrician," in a comment, says it is evident that the consumer can only be a paying proposition to the supply undertaking if the necessary costs of installation are reduced to a minimum, and if he pays his fair share of the expenses. But our contemporary is not very enthusiastic. It hopes the near future will see the addition of a large number of small consumers to the mains of every electricity supply undertaking in the country. It thinks, however, that the additional load will increase the responsibilities of the already harassed station engineer, and, under certain conditions, may prove the reverse of a paying source of revenue.

Converting the Percentage to the Flat-Rate.

Many electric undertakings are working with their pre-war charges, *plus* a percentage; and this has now become a little irksome. The possibility of the war lasting so long as it did was not contemplated, nor did anyone consider that the flight of costs would take a consistent upward course to this time. So the percentages have fattened and waxed in strength. Now it is quite apparent that a considerable part of the costs represented by the percentage is of a permanent character; and as capital, maintenance, and renewal expenditure proceeds at the higher levels, the permanence of additional costs will become hardened. The only thing that can reasonably be done, unless the percentage is considered by the electrical people to be worthy of retention as a memento of the war, is to convert it into part of the flat-rate, and so start afresh. This has been done at Whitehaven, for the purpose of simplifying the accounts. Other undertakings will also have to consider this matter before long.

Studies in the Composition of Coal.—We have received from Dr. Rudolf Lessing reprints of the papers which he read some time ago before the Chemical Society, on the "Behaviour of the Constituents of Banded Bituminous Coal on Coking" and the "Mineral Constituents of Banded Bituminous Coal." The extent of the researches with which these "Studies in the Composition of Coal" deal will have been gathered from the abstract of the papers published in the "JOURNAL" for Jan. 27 last [p. 188].

Installation Costs and Housing Schemes.—There has been some discussion as to apportioning the costs of gas installations under housing schemes. It will interest readers to know that the Housing Committee of the London County Council have made arrangements with the Brentford Gas Company for the supply of gas to the houses to be erected on the Roehampton Estate, and for the necessary installation in connection therewith, subject to the Council's contributing £10 per installation towards the initial cost.

"Industrial Administration."—There have been collected in book form a series of eight lectures upon subjects connected with "Industrial Administration;" the lecturers being recognized authorities on the particular aspects of the several questions with which they deal. For instance, there is one on "Occupational Diseases," by Dr. T. M. Legge, C.B.E., D.P.H., Medical Inspector of Factories; and another on "Atmospheric Conditions and Efficiency," by Dr. Leonard Hill, F.R.S., Director of the Department of Applied Physiology, Medical Research Committee. Then "Industrial Councils and their Possibilities" is a topical matter explained fully by Mr. T. B. Johnston, J.P.; and "Industrial Fatigue" is dealt with by Dr. A. F. Stanley Kent, M.A., Director of the Department of Industrial Administration in the College of Technology, Manchester. In relation to factory work, "welfare" is much talked of nowadays, and is considered to a growing extent as it gets to be better understood. A large quantity of reliable data is now available for those who desire to make a close study of a question which has been abundantly proved to have an enormous effect on work done; and much of this information is to be found in the lectures now under notice. They were delivered in the Department of Industrial Administration in the College of Technology, Manchester, during the session 1918-19, and have been printed now by permission of the department. The publishers [to the Manchester University Press] are Messrs. Longmans, Green, and Co., No. 39, Paternoster Row, E.C. The price of the book is 7s. 6d. net.

FUEL RESEARCH BOARD REPORT.

In last week's "Journal" there were reproduced the portions relating to "Gas Standards" and the "East Greenwich Fuel Research Station" of the report for 1918-19 of the Fuel Research Board of the Department of Scientific and Industrial Research. Some other matters dealt with are now to be noted.

The Problems before the Committee.

In our previous report, say the Committee, we put forward a scheme of research which was based upon what we believed to be a statesmanlike view of the fuel question as it concerns the nation at large. Great stress was laid on the importance of regarding the question as one which might involve the replacement of tens of millions of tons of coal, at present burned in the raw state, by the products of carbonization of this coal—gas, oils, and coke—in which the potential thermal units are in a higher state of availability, and are therefore more valuable for special purposes. It was further insisted that the replacement to any adequate extent of raw coal by the products of its carbonization must depend on the solution of technical and economic problems in ways which would justify their application on an enormous scale.

The established position of the two great carbonization industries—the manufacture of metallurgical coke and the manufacture of coal gas—was referred to; and the part taken by these industries in the replacement of raw coal by the products of its carbonization was fully recognized. It is hardly necessary to point out that the important part which these industries ought to take in the fuel developments of the future was not ignored or under-rated by us; for our views on that aspect of the subject are clearly set forth in our report to the Board of Trade on Gas Standards.

There are, however, important considerations which cannot be ignored in dealing with the wider problems of the replacement of raw coal by other forms of fuel. Gas and coke making are industries established with the primary object of supplying these products for definite purposes to assured bodies of consumers. Both industries, it may be assumed, will naturally develop and expand on somewhat their present lines, and will continue to find wider markets for their principal products and bye-products.

Outside the fields covered by these industries, however, there are less-known territories which are open for exploration. One of these is the carbonization of coal at temperatures much below those used in the coke and gas making industries. For many years individual explorers have been making expeditions into this new territory; but, as pointed out in the report, the time had come when the solution of the fuel problems of the future appeared to require that a more highly organized expedition should be sent out into this new region, with more adequate resources, and with wider aims than had been within the reach of any of the earlier explorers. Our views on this subject were influenced by two leading considerations. The first of these was the possibility which was opened-up of developing an important home source of fuel oil for the Navy; the second was the pressing need which exists for a smokeless solid fuel for domestic and industrial purposes. These considerations will be dealt with more fully in the sequel.

From the foregoing, it will be seen that we desired from the outset to attack the task which had been committed to us from the widest point of view, and that, having reached certain generalizations on the larger aspects of fuel conservation as a national question, we thought it right that these should be set forth as clearly as possible for the information, and we ventured to hope the sympathetic consideration, of those who were concerned in the issues.

The next step called for the passing from these general principles to particular and concrete proposals for a direct attack on the problems which were involved; and a scheme of research, requiring for its experimental development a fuel research station of an entirely new type, was proposed, and was in due time approved by Lord Curzon, and the necessary expenditure sanctioned by the Treasury.

In enunciating these general principles, and in putting forward a scheme of research, the reasons which led up to these proposals were stated; and it was further made clear that the future development of the matters to be dealt with would depend to a great extent on the active co-operation of outside experts and of leaders in those industries in which fuel conservation might be expected to play an important part.

We were well aware of the mass of knowledge which already existed on the practical side of fuel economy, as individual members of the Board had themselves for many years taken an active part in the development of this knowledge and in its practical application. It did not, therefore, occur to us that the scheme we put forward would be regarded as in any sense ignoring or making light of this existing mass of knowledge and experience on the economical use of fuel, or that its adoption could be taken by users of fuel as an excuse for holding-back from giving effect in their daily practice to the best existing knowledge.

The new conditions which are likely to affect the future production of coal and its cost to the consumer have brought the need for economy so forcibly before the nation that it seems desirable that the immediately practicable side of fuel economy, as distinguished from these further-reaching proposals, should be referred to in this report.

The Immediate Importance of Fuel Economy.

The outstanding feature of the situation appears to be that, while, on the one hand, there already exists among experts a widespread knowledge of means whereby the extravagant methods of consuming fuel which are widely prevalent might be so improved as to reduce the consumption for industrial purposes by a very substantial amount, there is, on the other hand, still so much inertia on the part of the consumers that even the simplest and the most obvious steps towards improvement are not taken. We believe that this inertia will inevitably be overcome by the great and permanent increase in the cost of coal. Indeed, instances are known to us in which this forward movement has already begun. At the suggestion of the President of the Board of Trade, we are now considering in what way these obvious facts as to fuel economy may be kept before the consumers of fuel for industrial purposes.

It has been generally accepted that one of the main sources of the industrial prosperity of the nation during the nineteenth century was the abundant supply of good and cheap coal. It has not been so generally recognized that the abundance and cheapness of these supplies have been mainly responsible for the reckless extravagance in their use which has almost universally prevailed. Those who have been in a position to study the matter at close quarters for the past forty or fifty years have come to recognize that the periodically recurring fluctuations in the price of coal have been attended by similar fluctuations in the interest shown by consumers in the development of more economical methods for its consumption. The periodical revival of this interest during times of high prices has certainly stimulated and kept alive the movement towards economy; and it would be wrong to under-estimate the great advances in many directions which have resulted. But the recurring periods of cheapness have invariably been attended by a general falling-off in interest in economy; and a steady continuity of this interest has only been maintained by a relatively small number of consumers. Not merely the intermittent and generally brief nature of the stimulus to economy caused by high prices, but also the relatively moderate range of the fluctuations in price, has prevented the development of any public sentiment of adequate depth and permanence. It is desirable, therefore, that attention should be called to the bearing of these past experiences on the situation in which the consumers of coal will now be placed by the great and permanent increase in price with which they are faced.

In the past, large consumers have been seriously embarrassed by relatively moderate increases in prices which were in themselves low. To-day, large consumers, who before the war considered a rise in price from 7s. to 10s. per ton was a sufficiently serious matter to call for closer attention to economy, are paying 25s. to 30s. per ton, and are faced with the prospect that, instead of a reduction to pre-war prices, which they had confidently anticipated, the present prices may not only be maintained, but may even be permanently increased. The consumer is not merely stimulated in the direction of increased economy; he is being driven there if he means to keep his place in industry.

There are dangers in the sudden application of this overpowering force; for it will certainly lead in many cases to hasty and ill-considered action. It is necessary, therefore, that the leaders of industries whose future will be seriously affected by the increased cost of fuel should, without loss of time (yet without undue haste), carefully review the whole situation and its possibilities as a preliminary to laying-down their future programme for the most efficient use of the fuel they consume.

Any such programme should deal first with the prevention of the mere reckless waste which invariably tends to develop in all works unless there is continuous skilled control. Even in works which are in other respects well managed, actual waste of coal in furnaces, and of steam at every point in a general distributing system, always grows rapidly but unnoticed, unless it is the duty of some one overseer to watch the consumption, and keep daily records of coal received and of heating work done.

It cannot be too strongly urged that the establishment in every large works of an organized fuel control is the only sound foundation on which to build more revolutionary or further reaching methods of fuel economy. It is hardly necessary to say that this is not urged as the first step towards economy because of any lack of belief on the part of the Fuel Research Board in the future of wider developments in the more scientific use of fuel, but because, on the one hand, substantial savings in the consumption of coal will at once result from the general adoption of fuel control under existing conditions, while, on the other hand, none of the wider developments can be permanently and really efficiently carried out without the previous establishment of this control.

As regards future fuel developments of a far-reaching character, reference must be made to two important considerations which arise out of the present situation. Even those who are most in touch with these developments have not yet had time to work out the probable effect on them of the permanent increase in the price of coal. One ton of good coal burnt under the ideal conditions of the calorimeter should give about 30 million B.Th.U. With coal costing 30s. per ton, the cost of a million thermal units is therefore 1s. It is obvious that the economics of the more elaborate methods for the preparation and use of coal must now

be scrutinized from the point of view of the enhanced cost of the thermal unit at its source—the coal.

Any process for the preparation of gaseous or liquid fuel necessarily involves the sacrifice of a proportion of the 30 million thermal units. In some cases this sacrifice amounts to as much as one-third, or 10 million units. With coal at 30s., the sacrifice amounts, therefore, to 10s. per ton; and the process, to be economically sound, must show advantages which are at least equivalent to this loss. When coal could be bought for 9s. per ton, the corresponding sacrifice was only 3s. Even if the prices of the bye-products of carbonization and gasification were raised to, and maintained at, correspondingly higher figures, it does not follow that the enhanced cost of the thermal units sacrificed would be met. The increase in rates of wages, in the capital costs for the erection of new plant, and in the revenue charges for its maintenance, are factors of equal importance.

It follows from these considerations that, in any practical programme for fuel economy, the first place ought to be assigned to the putting in order without loss of time, by the consumers themselves, of a system of control which will ensure that a stop shall be put to gross waste, and that the existing appliances and known methods are worked to the best advantage. There is no doubt that in the majority of industrial undertakings a reduction of from 5 to 20 p.ct. could be secured within a year at a relatively trifling expenditure on wages and small alterations of apparatus. In one case known to us a saving of 30 p.ct. on the fuel consumption was effected during the past year merely by the application of more perfect control.

Of the wider schemes for the more scientific use of fuel, much is already known which may profoundly affect the consumption of coal. In coke-making in its association with the iron and steel industry, as well as in undertakings for the supply of town gas and electricity, great economies may be introduced. From their very magnitude, however, these schemes can only very gradually tell on the national coal consumption; and it would be most unfortunate if any sanguine views as to their ultimate potentialities were to lead consumers to neglect the immediate duty of at once putting the fuel consumption of their works on a more economical basis by the organization of proper control within each of these works, as well as at the administrative headquarters of each concern. Even so modest a saving as 5 p.ct. on an annual consumption of 100 million tons of coal would, at present prices, amount to a saving of from five to eight millions sterling.

The considerations which influenced us in our decision to organize an exhaustive experimental inquiry into the carbonization of selected coal at temperatures much lower than those used in the gas and coke making industries, were: First, the desirability of obtaining a home source of fuel oil for the Navy; and, secondly, the need which exists for a smokeless solid fuel for domestic and industrial use.

Oil-Fuel for Ships.

The next section of the report deals with oil-fuel for the navy and the mercantile marine. Reference is made to the inquiry by the Royal Commission in 1912-13; and it is remarked that the shortage of oil during the war provided an object-lesson which cannot safely be ignored even in times of peace. While the immediate needs of the navy will fall more or less to the pre-war standard, the increasing adoption of fuel-oil by the mercantile marine may ere long call for supplies of fuel-oil far in excess of those required by the navy. Further demands will also arise from the rapid development of the use of Diesel and semi-Diesel engines. The development of home sources of fuel-oil is, therefore, of increasing importance from a national point of view; and events have more than justified the placing of this subject in the forefront of the programme of research at the research station.

In the report to the Royal Commission, the position taken was that, in the tens of millions of tons of bituminous coal which are at present burned in the raw state, there may be a possible source of home supplies of fuel oil on something like the scale required by the navy. For every million tons of fuel oil derived from this source, from 15 to 20 million tons of coal would need to be diverted from other channels of consumption, and passed through a process of carbonization.

It was shown that, as only from 5 to 8 p.ct. of the coal could be obtained as fuel oil, the finding of suitable markets for the other products of carbonization was at the root of the economic problem. Of these products, by far the most important from this point of view is the coke, which amounts to from 65 to 70 p.ct. of the original coal.

The data mainly used in this report had been obtained from experimental work on a small industrial scale which had been carried out in Glasgow, under the direction of Sir George Beilby, for a period of four years. This experimental work was continued till the outbreak of war in 1914.

In these experiments only non-caking bituminous coals were used; so that the resulting coke was soft and friable, and quite unsuitable for transport. Most of it was converted into fuel gas in producers of the Dellwik type; but a considerable quantity was converted into small ovoid briquettes suitable for use as a smokeless domestic fuel. These briquettes were tested as a domestic fuel for many months, not merely by the staff who were engaged in the experimental work and their personal friends, but by a large number of consumers spread over the City of Glasgow. The results of these tests were, on the whole, most encouraging, though the coal used was of indifferent quality from the house coal point of view.

At the outset of the Glasgow experiments, one of the applications of low-temperature carbonization which was much in mind was its use as a preliminary to the gasification of raw coal in gas-producers of the ammonia-recovery type. As one of the early pioneers in this method of fuel gas production, Sir George Beilby had for long seen that this preliminary carbonization would be of great advantage, as it would completely get rid of the trouble caused by the caking of the raw coal in the producers, while the gas produced would be quite free from tarry and oily impurities. The latter would obviously be of great advantage when the gas was to be used in gas-engines. Had the war not intervened, he believes that this particular application would have been already in use on a large scale in works in which he is interested. But the revolutionary changes in the coal situation which have taken place during the past year have so transformed the economic outlook for fuel-gas processes of this type, that the fundamental data on which they were based must be revised, and the whole situation must be considered from the new point of view.

Under the new conditions of coal production and prices, the Board are satisfied that an outlet for low-temperature coke on a sufficiently large scale, and at remunerative prices, is more likely to be found in the supply of a smokeless solid fuel for domestic and industrial purposes. Could any considerable part of the 35 million tons of coal normally burnt in domestic fires be replaced by this smokeless solid fuel, a substantial contribution to the supplies of fuel oil would be secured. This replacement would also go a long way towards the abolition of the smoke nuisance in large towns.

Before dealing in detail with the question of solid smokeless fuel for domestic and industrial purposes, reference is made to questions which arose owing to the threatened shortage in the supplies of fuel oil for the Navy during the war. The Director (Sir George Beilby) was in close touch with the Admiralty, the Ministry of Munitions, and latterly the Petroleum Executive regarding the risk of shortage, and as to the possibilities for the development of emergency supplies of oil from home sources. The only practical steps in this direction which were at all feasible during the war were the development to the utmost of the Scotch shale industry, and the diversion of as much as possible of the heavy oils produced by the gas and coke-oven industries for such uses by the Admiralty as would set free a corresponding amount of imported oil for use at sea. The Director strongly represented to the Admiralty and Ministry of Munitions from the first that these possible contributions of fuel oil from home sources were so small relatively to the war demands of the navy that any hopes based on them were bound to prove illusory, and would, in fact, be a positive danger if they led to any diversion of effort from the maintenance of oversea transport of supplies. In November, 1917, a report on the work of the Petroleum Research Department of the Ministry of Munitions was presented by the Director, the late Sir Boverton Redwood, Bart. In March, 1918, the Minister of Munitions appointed a Committee, whose conclusions were: (1) That the scheme for the carbonization of cannel coal and kindred substances recommended in the Petroleum Research Department's report was not a practicable one, and that the Ministry of Munitions were justified in declining to embark on it. (2) That the alternative policy of developing the production of fuel oil from cannel coal and kindred substances in existing vertical retorts at gas-works should be developed within limits indicated. (3) That the decision of the Ministry of Munitions to erect a battery of the Chiswick form of retorts was the right course to adopt in the circumstances.

The position as regarded emergency supplies of fuel oil from home sources therefore remained as already set forth.

When the Fuel Research Board was instituted in 1917, the pressure for supplies of fuel oil was reaching a maximum; and, while no hopes were held out that any results of the proposed scheme of research could have any possible effect in relieving this pressure during the war (indeed, any such possibility was definitely negatived), it was pointed out to the War Cabinet that the question of obtaining large quantities of fuel oil for the navy by the diversion of millions of tons of raw coal into entirely new channels ought to be independently and exhaustively studied, in order that a definite decision as to the possibility or the impossibility of the proposal should once for all be arrived at.

The Position Summarized.

The position may be summarized as follows:

> If bituminous coal is to become an important source of home supplies of fuel oil for the navy and mercantile marine, tens of millions of tons per annum of coal, which is at present burned in the raw state, would need to be subjected to a preliminary process of carbonization, and thereby split up into gaseous, liquid, and solid fuels, which collectively would be used to replace this raw coal for the purposes for which it is at present consumed.

Broadly, there are three methods of carbonization which have to be considered. These are:

1. The gas-works process, as carried out in horizontal or vertical retorts at temperatures ranging from 1000° to 1300° C.
2. The coke-works process, as carried out in recovery ovens at temperatures from 1200° to 1300° C.
3. The process now under review, in which temperatures much lower than those used in (1) and (2) are employed.

As regards (1) and (2) as they exist to-day, the quantity of fuel oil

suitable for the navy which is produced from one million tons of coal is relatively so small that it need not be seriously considered in dealing with the broad question of home supplies. Prior to the war, regular outlets existed for the whole produce of both these industries; and it may fairly be expected that these outlets will continue to expand, side by side with the natural developments of the industries. In considering the part which might in the future be played by (1) and (2) as home sources of fuel oil, it is the carbonization processes that they employ, rather than the industries themselves as they at present exist, which must be taken into account.

The significance of modern developments in the gas industry is referred to later; but, in this connection, it ought to be noted that the present movement is all in the direction of obtaining the highest possible proportion of the total thermal units of the coal in the form of gas, which can be distributed to the ordinary consumers. In other words, the gas maker is aiming at doing an increasing business in the distribution of thermal units in the form of gas on a smaller consumption of coal per million thermal units distributed. No development, therefore, of the gas industry on lines of the present process of carbonization at 1000° to 1300° C. will help towards the production of fuel oil for the navy.

Whether either the gas-works or the coke-works form of carbonization at 1000° to 1300° C. could, under certain conditions, be used as an alternative to carbonization at much lower temperatures in any broad scheme for the replacement of coal at present burned in the raw state, is a question which will not be lost sight of, though it cannot be further discussed at present.

The Research Station.

It was recognized that the real pioneering work of the station would have the best prospects of success if the undivided atten- of the experimental staff could be concentrated on the new and untried elements of the problems with which they would have to deal. Experimental work of the type which is to be carried out has too often been rendered difficult or even impossible through the absence of the most elementary facilities for the selection, handling, and measurement of raw material and products, and for the provision and regulation of the heat required by the operations. It is believed that facilities of this kind have been secured by the lay-out and equipment of the station. These fundamental features may be briefly summarized as:

1. The organization of a survey department for the collection and registration of all information relative to the types of coal available in the various coal-mining districts, and for the maintenance of constant touch with the mining experts in these districts, who will advise on the selection of the coals to be experimented with for particular purposes.
2. The provision of permanent installations for:
   - (*a*) The reception, weighing, and distribution of the coal to be carbonized or gasified.
   - (*b*) The collection, measurement, and storage of the gaseous and liquid products of carbonization or gasification.
   - (*c*) The collection, weighing, and distribution of the coke or char produced.
   - (*d*) The supply and measurement of the heat used in every operation, so that an exact thermal balance-sheet can always be drawn-up.

By the provision of this organization, the pioneering as well as the general experimental work will start from a foundation which could only be secured by the establishment of a self-contained station specially designed for the work to be carried out.

The Carbonization Inquiry.

It was recognized from the outset that, in the pioneering work on carbonization, many forms of apparatus might have to be tried and rejected before an industrial unit of a thoroughly practical character could be evolved. In the lay-out of the station due provision has been made so that the alteration or replacement of this type of apparatus can be carried out without interfering with the more permanent plant. The roomy carbonization house, with its overhead travellers, will lend itself admirably to to these purposes.

The steps in the carbonization inquiry will be:

1. To obtain exact knowledge as to the quantities and qualities of all the products resulting from the carbonization of suitable coals over a considerable range of temperatures.
2. To obtain exact knowledge as to the physical and mechanical conditions which influence the carbonization of various types of coal under prescribed conditions of time, temperature, and mass.
3. To evolve a form of apparatus which is mechanically, as well as economically, sound. To this end a study must be made of the behaviour of materials of construction, including cast iron and steel, under continuous working at various temperatures.

Having ascertained the quantities and qualities of all the products which result from the carbonization of various types of coal, the economical disposal of these products will open-up a further vista of pioneering work.

National Association of Technical Gas Officials.—A meeting of the South Wales District of the Association was held last Thursday, at Cardiff. It was well attended by senior and junior members; and district officers were elected.

FUEL HANDBOOKS FOR THE STUDENT.*

The two students' handbooks, on "Industrial Gases" and "Fuel Production and Utilization" respectively, which are now before us are the first two of a series of volumes on the chemical industries, which are being published under the general editorship of Dr. Samuel Rideal. They are specially intended for the use of the advanced student, with a view to supplement his academic training with a presentation of the realities of chemical industries. The aim is excellent; and it is probably carried into effect in this series of volumes as well as is possible in a world where the ideal authors of such handbooks are precluded by other claims from giving the student the benefit of their ripe practical experience of works' processes and developments.

It was in regard to the production of ammonia from atmospheric nitrogen that Dr. Greenwood promised to become a leading authority; and his untimely death not long since is a real loss to a branch of industry which is in its infancy in this country. He had assisted in the compilation of a useful *brochure* of "Physical and Chemical Data of Nitrogen Fixation," which was published by the Inventions Department of the Ministry of Munitions in December, 1918, and forms a handy collection of graphs and diagrams for anyone who is investigating *ab initio* problems of nitrogen fixation, hydrogen separation, &c. Dr. H. S. Taylor, the author of the second work under review, also assisted in compiling this Ministry of Munitions' publication; and the influence of association with the Research Department of the Ministry clearly runs through both these volumes.

Dr. Greenwood's treatment of the subject of Industrial Gases is divided into three main parts—viz.: (1) The Gases of the Atmosphere. (2) Hydrogen, Carbon Monoxide, Carbon Dioxide, Sulphur Dioxide, Nitrous Oxide, Asphyxiating Gases. (3) Gaseous Fuels. The subject of hydrogen production is treated rather from the academic standpoint; and yields and costs are generally given only from pre-war data. The last part of Dr. Greenwood's book is the briefest of the three, though it deals with the all-important technical subject of gaseous fuels. It is sketchy in the extreme, and there is not even a mention of acetylene, which has assumed immense importance as a gaseous fuel for special industrial uses.

Dr. Taylor opens his book on "Fuel Production and Utilization" with a general introductory section, dealing with raw materials, gaseous equilibria, combustion, &c. Both he and Dr. Greenwood frequently use the Centigrade-pound unit of heat in place of the calorie or the B.Th.U. (which they write "B.Th.U." or "B.T.U." with great impartiality—Dr. Taylor in two consecutive pages has six of one spelling to five of the other!). This is, we think, a regrettable innovation, as is also the general use of the initials "K.C.U." for the (large) calorie. Dr. Taylor falls into the too common academic error of stating that the net calorific value of a gas containing hydrogen—*e.g.*, methane—actually represents the available heat from its combustion when the gaseous products pass away at such a temperature that condensation is not possible. Obviously, it is not the available heat in any circumstances, because it includes the heat capacity of the gaseous products other than water vapour on cooling from the boiling point to room temperature. We are glad therefore to note that Dr. Taylor ultimately points out that "so long as it remains customary to work in terms of net units, and not in terms of gross units, just so long is the utilization of the calorific value of the fuel imperfect." Fortunately, the fetish of "net" calorific power has been overthrown in connection with the gas industry.

These two books share, with many recent students' text-books, the grave fault of giving half-proven theories precedence over established facts. In our view, the latter should be first clearly stated, and theories which are more or less in keeping with them, but are certainly not indubitably proved, may then be propounded with caution. The practice of propounding a theory and subsequently mentioning a few facts which give it a measure of support is thoroughly reprehensible from the truly scientific standpoint. The student should be trained to ascertain and accumulate facts and yet new facts, and to postpone the less laborious task of building theories until the foundation for them is adequate. Students who will take the trouble to sift fact from theory should find both these volumes very useful for study and reference.

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* "Industrial Gases," by Harold Cecil Greenwood, O.B.E., D.Sc., F.I.C., Scientific Adviser to the Munitions Inventions Department, &c. London: Baillière, Tindall, and Cox; 1920. [Price 12s. 6d., net.]

"Fuel Production and Utilization," by Hugh S. Taylor, D.Sc., Assistant Professor of Physical Chemistry, Princeton University, New Jersey, U.S.A. London: Baillière, Tindall, and Cox; 1920. [Price 10s. 6d., net.]

Sulphur in Cold Producer Gas.—Writing in "Chemical and Metallurgical Engineering," Mr. C. F. Kauffmann says he arranged for an extensive series of analyses for the purpose of ascertaining the quantity of sulphur contained in the coal, the amount going down with the ash, the quantity carried over by the raw gas, the quantity absorbed by water in both the primary and secondary condensers, the quantity carried off in the tar, and the quantity that is finally present in the clean cold producer gas. The results were: Sulphur content in ash, 9·13 lbs.; in water, primary condenser, 649·79 lbs.; in water, secondary condenser, 320·22 lbs.; in tar, 8·74 lbs.; in gas (ultimate analysis), 73 78 lbs.; sulphur content unaccounted for, 4·43 lbs.; sulphur content in coal, 1066·09 lbs.

NORTH OF ENGLAND GAS MANAGERS' ASSOCIATION.

Annual Meeting at Newcastle-on-Tyne.

The Annual General Meeting of the North of England Gas Managers' Association was held last Saturday afternoon in the Neville Hall of the Institute of Mining and Mechanical Engineers, Newcastle-on-Tyne. Mr. HAROLD E. BLOOR (the President) was in the chair. There was a large attendance.

APOLOGIES FOR NON-ATTENDANCE.

Letters of apology for non-attendance were read from Sir Dugald Clerk, the President of the Institution of Gas Engineers; Mr. J. R. Duff, the President of the Midland Association of Gas Managers; Mr. Arnold W. Branson, the new President of the North of England Association; Mr. Thomas Waddon, of Newcastle, and Mr. W. W. Townsend, of Colchester.

STATEMENT OF ACCOUNTS.

The statement of accounts for the year showed a balance of of income over expenditure of £52 3s. 9d. The subscriptions of 113 members amounted to £59 6s. 6d., and of 77 associates to £40 8s. 6d.—a total of £99 15s. The expenditure amounted to £69 6s. 7d.

The HON. SECRETARY (Mr. Herbert Lees), in presenting the balance-sheet and moving its acceptance, called attention to the fact that there were arrears of subscriptions amounting to £18 18s. He hoped that this sum would be speedily wiped-out.

The financial statement was agreed to.

THE MEMBERSHIP ROLL.

The following new members and associates were elected:

Members.

Mr. Albert Walfrid Wikner, of Newcastle-on-Tyne.
Mr. Thomas Conn, of Featherstone, near Pontefract.
Mr. A. T. Harris, of Maryport.
Mr. William Walker Athey, of Stockton-on-Tees.
Mr. Hedley Hoy, of Workington.

Associates.

Mr. Bernard Richardson, of Newcastle-on-Tyne.
Mr. George Edwin Anderson, B.Sc., F.C.S., of Willington Quay-on-Tyne.
Mr. Herbert Percy Chant, of Redcar.

ELECTION OF OFFICERS.

The ballot on the nomination for officers for the ensuing year resulted in the following being appointed:

President: Mr. Arnold W. Branson, West Hartlepool.
Vice-President: Mr. F. C. Willis.
Committee: Messrs. J. E. Blundell, J. Kelly, and Norman Reid.
Hon. Secretary and Treasurer: Mr. Herbert Lees.
Hon. Auditor: Mr. Charles H. Armstrong.

DONATION TO THE INSTITUTION BENEVOLENT FUND.

On the motion of the PRESIDENT, it was resolved, on the recommendation of the Committee, that a donation of £10 10s. be contributed to the Benevolent Fund of the Institution of Gas Engineers.

PLACE OF NEXT MEETING.

It was agreed that the next meeting of the Association be held at West Hartlepool. The half-yearly meetings have hitherto been held on Saturdays; but the President intimated that in the past twelve months there had been a considerable feeling among the members against the meetings being held on that day. He moved that the next meeting be not held on a Saturday; and after a little discussion, the proposal was carried unanimously.

PAPERS READ.

Mr. RUFFHEAD then read his paper on "Recent Extensions at Darlington Gas-Works." This, together with a report of the discussion to which it gave rise, will be found on p. 258.

Mr. GEOFFREY WEYMAN contributed a paper on "Oxide Purification." This will be found on p. 256.

VOTES OF THANKS.

Mr. J. KELLY (Bridlington) moved a vote of thanks to the readers of the papers.

Mr. HERBERT LEES, in seconding, said they were very grateful to Mr. Weyman for having prepared a paper at short notice.

The motion was agreed to with acclamation.

Mr. R. NELSON (East Hull) moved a vote of thanks to the retiring President, the Committee, the Hon. Auditor, and the Hon. Secretary—Mr. Herbert Lees.

Mr. J. E. BLUNDELL (Carlisle) seconded the proposal; and it was heartily carried.

This concluded the business. Tea was afterwards served in the library of the Mining Institute.

According to the preliminary figures of the Geological Survey for 1919, the output that year of bye-product coke in the United States exceeded that of beehive coke. The bye-product plants yielded 25,171,000 tons; while the output of the beehive ovens is estimated at 19,650,000 tons.

MIDLAND JUNIOR GAS ASSOCIATION.

Annual General Meeting.

The Annual General Meeting—the Fifteenth Session—was held in Birmingham, in the Reading Room at the Council House, on Thursday last. The chair was occupied by Mr. C. CARRINGTON BARBER, the President; and about 25 members were present. Dr. E. W. Smith, who is an Hon. Member, was also present.

ANNUAL REPORT.

The HON. SECRETARY (Mr. H. W. Dean), before the discussion of the annual report of the session's work, copies of which had been circulated among the members, gave a detailed explanation as to two or three matters with a view to facilitating discussion. He referred to the relationship of the Junior Associations to the newly-formed National Association of Technical Gas Officials. At their opening meeting of the present session, a representative of the Association had explained to the members the aims and objects of the new body; and in December last a representative from their own Council had attended a meeting in London, when draft rules were considered. Another point remarked upon was the question of uniformity of rules concerning the English Junior Gas Associations. This matter was receiving the attention of the Joint Council. He reminded the members also that it had been decided to make their subscription an inclusive one, along with the other Junior Associations, in reference to the volume of Joint "Transactions." Lastly, he mentioned the matter of education, and stated that Mr. J. G. Clark was now the representative for the Juniors on the Education Sub-Committee of the Institution of Gas Engineers.

Dr. E. W. SMITH proposed the adoption of the report. Speaking of the question of education, he remarked that it was high time a report was forthcoming from the Committee concerned. This was a matter which called for full discussion, both by Junior and Senior Associations, before they pledged themselves to any particular scheme. The success of the session's work, he felt, was largely due to the efforts of the Hon. Secretary, who had kept the members fully informed on all matters by interim reports.

Mr. T. H. POULSON (Stafford) seconded the adoption of the report, and pleaded for better support of the Council by the members generally. The apathy of many members in attending meetings was to be deplored.

The report was then adopted unanimously.

STATEMENT OF ACCOUNTS.

The HON. TREASURER (Mr. T. F. E. Rhead, M.Sc.), in presenting the balance-sheet, mentioned several points in explanation of the printed statement. The loss on the year's work (£18 13s. 3d.) appeared to be rather a large one; but he remarked that they had assets, which would be shortly available, in the form of subscriptions due, and payments for "Transactions" issued, which amounted to £19. Their assets at the last annual general meeting were only equivalent to £6; so that the difference of £13 went a long way to effacing the loss on the session. The expenditure had been at about the same per event (£3 on the average) as in the previous session, although they had 18 items on the list as against 8 for 1918-19; while the cost of travelling for delegates to meetings in other towns had also considerably increased. Moreover, they had not requested subscriptions from hon. members for the present session; and their income from this source was down by about £9 as compared with the previous session. Altogether, he thought the Association were in a fairly healthy position.

Mr. F. R. AYRE (Birmingham) proposed that the statement of accounts be adopted, and remarked that, having regard to the large amount of work done, they might regard their financial status as one which need occasion them no alarm.

Mr. B. J. BELL (Birmingham), in seconding, remarked that at meetings which their delegates attended discussion was for the benefit of all the members, and the latter would surely wish that the Association should be in the forefront of any activities.

The statement was then adopted unanimously.

ELECTION OF OFFICERS.

The PRESIDENT announced that the Council had elected Mr. C. F. W. Rendle, of Redditch, as the new Junior Vice-President.

The following new Members of Council were then elected, to replace retiring members:

District Members of Council: Mr. J. Poulson (Stafford) and Mr. W. R. Reed (Leamington).
Birmingham Member: Mr. W. B. Cobb.

The co-option of Mr. W. J. Pickering as a Birmingham member of Council, which took place after the last annual general meeting, was also confirmed.

The HON. SECRETARY (Mr. H. W. Dean) volunteered his services for another session—an offer which the members present heartily approved.

The HON. TREASURER (Mr. Rhead) intimated that he was compelled to relinquish office by reason of stress of duties. Mr. J. H. Gee (Birmingham) was elected in his stead.

VOTE OF THANKS TO OFFICERS.

Mr. L. STURDY proposed, and Mr. G. W. ROBSON seconded, a hearty vote of thanks to the officers of the Association, for the good work they had done during the session.

This was carried enthusiastically; and the meeting concluded.

OXIDE PURIFICATION.

By Geoffrey Weyman.

[A Paper read before the North of England Gas Managers' Association, May 1.]

Oxide purification is a very complex subject; and, like many other things, the more you seek the more you find. The apparent simplicity—a simplicity which only exists on the surface—has done a great deal of harm in preventing detailed work on the subject; but the fact that the results of purification have not been so consistent as one would expect from the very simple chemical equations usually given, should lead to more attention being paid to the subject in the future. The following cannot be regarded as more than a summary of the principal theoretical points; and I hope to deal with the practical side of the question before you at your auxiliary meeting in the near future.

The process is, chemically speaking, catalytic in the sense that the combination of hydrogen sulphide and oxygen is promoted by a third substance, ferric oxide; the latter ultimately appearing without change. The action is, of course, only partial, as the sulphur is not fully oxidized, but appears as free sulphur. As will be seen later, it is possible to carry the oxidation to the full extent when the sulphur appears as sulphuric acid, in combination with the iron.

Unlike some other catalytic reactions, we can isolate—and originally it was part of the process to isolate—the intermediate compounds, the sulphides. By doing this, we can follow to a large extent the part played by the iron in the reactions. It is not necessary to have iron oxide present in order to get hydrogen sulphide and oxygen to react; but it is convenient to do so in order to reduce the conditions to nearer normal—conditions we can more easily control. On the other hand, it is advantageous to accelerate the reaction as far as possible, and limit the formation of the sulphides to a very short duration of time, since by so doing we can avoid the necessity of removing our purifying material to the open air to oxidize.

Properties of Ferric Oxide.

One of the factors influencing the reaction is the condition and activity of the catalyst. It is therefore essential to have a clear view of the properties of ferric oxide. There is little doubt now that iron forms a complete series of hydrates. None of them is stable for more than a very small range of temperature. Any little alteration of temperature, therefore, will give a slightly different amount of water combined as hydrate. If you take the mud formed by the precipitation of a ferric salt by an alkali, and gradually dry it as the water passes off, new hydrates are formed at each successive temperature. Garnelley and Walker found a hydrate $Fe_2O_3.5H_2O$ which was stable at 15° C. At 55° C., it corresponded to $Fe_2O_3.3H_2O$; and at 100° C., to nearly $Fe_2O_3.H_2O$. In between these there is reason to believe that there are a great number of others. Similarly, on heating above 100° C., water is again gradually evolved, until in the neighbourhood of 400° C. a hydrate probably exists which is slightly more stable—$10Fe_2O_3.H_2O$. Water is not finally expelled until a temperature of over 900° C. is reached. Besides this water which is chemically combined, there may, of course, be water present in an uncombined state, which is usually termed moisture. It is obvious, however, that, as the hydrates give off their water so easily, it is for all practical purposes impossible to say how much water is chemically combined in any oxide. Nor does it matter. It will be seen that the maximum activity of ferric oxide is reached if the material is dried at a temperature of about 600° C. for many hours.

Certain of the hydrates on drying become partially or entirely inactive, though the activity is restored by heating to a higher temperature. This behaviour fortunately does not apply so much to hydrates precipitated quickly from hot solutions, nor to those which are the result of oxidation of a ferrous compound. It applies more to certain varieties precipitated in the cold by an alkali. It is a result of molecular changes; and it is this fact which has lead to a still prevalent belief that a large amount of water of hydration is essential for an efficient purifying material. This belief exists in spite of the work of former investigators. Lewis Thompson—probably the earliest chemist to specialize in gas-works chemistry, who was born at Byker, then near Newcastle-on-Tyne—in various articles, published 1850-1854, concluded that the activity depended upon the internal structure of the ferric oxide molecules, and not on water of hydration. Lewis Wright and others have since supported this view. Without going into detail, I would simply point out that ferric oxide is not built-up of simple Fe_2O_3 molecules, but of molecules containing very many of these groups of atoms bound together to form a complex molecule $(Fe_2O_3)x$. It is this internal arrangement which is presumably affected by the expulsion of water.

Water which is retained by oxide physically can exert a powerful physical influence, in a manner which is akin to suffocation. Hydrogen sulphide is a gas only feebly soluble in water; and if the oxide is surrounded by water, it will be obvious that the rate of absorption will be influenced by the rate at which the hydrogen sulphide can pass through the water to reach the oxide. Diffusion through a liquid is very much slower than through a gas; and hence in the presence of excess of water the reaction slows-down. If the oxide is dry, the hydrogen sulphide gains contact much quicker by diffusion through the gas contained in the interstices of the oxide. We know also, from both the laboratory and practical experience, that the sulphides of iron when wet oxidize very slowly indeed. In fact, oxidation is almost brought to a standstill if the sulphide is covered with water. Since the solubility of oxygen is very much smaller than that of hydrogen sulphide, the same explanation will apply. The comparatively slower rates of oxidation as compared with sulphidation when water is present can be observed in practice; for we find that, whereas the latter operation may take the whole time during which the gas passes through four boxes, the latter takes places in the first two.

Results of Fouling Tests.

In a table are given the results of fouling tests carried out on various preparations. The activity figure is the percentage of hydrogen sulphide absorbed per 100 grams of the ferric oxide (Fe_2O_3) present, divided by the theoretical amount (63·9 p.ct.) which ferric oxide is capable of combining with. It should be noted that the absorption was carried out at the ordinary temperature; but the heat developed by the reaction was allowed to develop without any cooling beyond that of the atmosphere.

It will be noticed that, on drying, some of the varieties fall very far short of the maximum activity. No preparation I have made gave the maximum activity when dried at 100° C. Most give the full activity when dehydrated at a temperature of about 600° C. At this stage the behaviour of the oxide is erratic. It may remain exposed to the action of the hydrogen sulphide for some time before absorption sets in; then the combination is very sudden. This curious behaviour can sometimes be noticed when using burnt oxide in practice. Above 700° C. the time of exposure to hydrogen sulphide has to be lengthened before anything happens, and becomes longer and longer till, for all practical purposes, the oxide is inactive. The duration of heating as well as the temperature affects the result. The phenomena can be produced in other ways than by heating; for Tomassi found that, if precipitated ferric hydrate is left for very prolonged periods in contact with water, part of the residue is inactive, part is active, and part suddenly "flashes-back" after an interval.

The inactivity of these varieties of oxide obtained by heating can be broken by raising the temperature of the oxide during exposure to the hydrogen sulphide, or sometimes by violent shock—such as, for instance, throwing the red-hot oxide into water. All the varieties I have prepared which were inactive in the ordinary way absorbed hydrogen sulphide freely if the temperature was raised. Under these conditions, as will be seen later, the reaction takes a somewhat different course.

Oxide of Iron in Common Use.

Turning now to the oxides of iron which are in common use, we may classify them as follows:

(1) True bog ores, practically restricted to the best Dutch and Irish bog ores and Belgian bog ores. (2) Degraded iron ores, produced by the action of weather on the exposed iron ores or rocks containing iron, under which are placed the local deposits, Westbury iron, Lincolnshire ore, &c. (3) Burnt pyrites and burnt spent oxide.

Of these, the true bog ore may be taken as essentially ferrous hydrate precipitated on peat fibre. On drying and exposure to air, it oxidizes to ferric hydrate. Dried at slightly over air temperature, practically all the iron is active; but when dried at 100° C., there is a distinct loss in activity. Owing to the extremely fine division and large surface covered by the iron, it is particularly effective, and is undoubtedly the easiest-worked material. The porosity and area covered by the iron make it possible to have present a very large amount of water without the activity being much affected.

The second group forms a very useful source of oxide; and there must be few localities in which such ores do not exist. The activity varies a great deal, according to the extent of the weathering action. Some may attain over 90 p.ct.; but the usual ore runs between 70 and 80 p.ct. But those with low normal activity can be worked profitably at somewhat higher temperatures. Usually such ores need preparation by crushing or grinding before they are used. They can never carry such a large amount of water as a bog ore, without serious loss of efficiency. Though fine grinding gives a larger surface, it can never approach the condition of bog ore; and I question very much whether advantage is gained by fine grinding before the oxide is put into use. It must not be thought that fine grinding will increase the activity. It can only accelerate the rate at which the absorption takes place.

The burnt oxide group consists chiefly of artificial preparations made up mainly of burnt spent oxide. Though burnt pyrites is more active than burnt spent oxide (for it has not been exposed to heat for the same length of time), there is not much available for purification. As the burnt material is slow and uncertain in its action, a certain amount of precipitated hydrate is usually mixed with it to give an initial activity. This should be sufficient to generate enough heat to start the bulk of the oxide into use. In reality, the use of such material means working at a higher temperature than would be necessary with a bog ore, for example. The oxide is denser even than the ores put under (2), contains more ferric oxide, and should absorb more hydrogen sulphide in a given volume of the material than the other ores.

Properties of the Sulphides.

Having briefly summarized the position in regard to raw material, the essential properties of the intermediate products—the sulphides—must next be considered.

Ferric sulphide, Fe_2S_3, is the primary product of the action of hydrogen sulphide on ferric oxide according to the equation—

$$Fe_2O_3\,Aq + 3H_2S = Fe_2S_3 + 3H_2O + Aq.$$

It oxidizes readily, with evolution of heat and separation of free sulphur; but in doing so, it certainly does not combine with all the water liberated by the sulphidation. The oxidation would be represented by—

$$Fe_2S_3 + O_3 + Aq = Fe_2O_3\,Aq + S_3$$

And we know that the ferric hydrate reformed is certainly not the compound $Fe_2O_3.3H_2O$, and probably contains less water than is represented by the formula $Fe_2O_3.H_2O$. At any rate, you have water liberated which is not going to be recombined, and unless removed will accumulate until the efficiency of the material is impaired. Ferric sulphide is decomposed by water at 100° C.; and the reaction of absorption is reversed—

$$Fe_2S_3 + H_2O + Aq = Fe_2O_3 - Aq + 3H_2S.$$

Ferric sulphide is not stable in the presence of acid. Under such circumstances, the iron is reduced and ferrous sulphide formed with liberation of sulphur—

$$Fe_2S_3 + n(H_2SO_4) = 2FeS + S + n(H_2SO_4).$$

Any ferric salt such as ferric sulphate, acts like free acid.

Now, among the secondary reactions which take place in practice is a very important one. Sulphur is slightly volatile in the presence of water vapour, and in this case can decompose steam with the ultimate formation of sulphur dioxide and hydrogen sulphide—

$$3S + 2H_2O = 2H_2S + SO_2.$$

Now, this reaction has been proved to take place in ordinary practice. It is reversible; for if you cool the products together in a confined space, water and sulphur are reproduced. On a large scale, where the products are not cooled in a confined space, traces of hydrogen sulphide are liberated; and sulphur dioxide soon makes its presence felt. This liberation of sulphur dioxide enormously increases the complexity of the process; and it is capable of forming compounds with a large number of other substances present. Sulphur acids are formed, and, under the acid conditions so set up, the ferric sulphide passes into ferrous sulphide.

Ferrous sulphide (FeS) is a very similar compound to the ferric sulphide. It is produced by the action of hydrogen sulphide on ferrous hydrate, or from ferric oxide as described above. As Gedel has pointed out, a different product is formed according as to whether you add a ferric salt solution to an alkali sulphide, or the alkali sulphide to the ferric solution. The former produces ferric sulphide, for the conditions are always alkaline; but in the latter case the conditions are always acid, and ferrous sulphide is formed. Ferrous sulphide, like ferric sulphide, is decomposed by water at 100° C.; but if free sulphur is also present, it will become stabilized, and partly passes into ferric disulphide. Probably molecular complexes of disulphide and ferrous sulphide are formed, which, on further heating, pass into the sulphides of the general formula, Fe_nS_{n+1}, such as Fe_7S_8, the sulphide grouping which exists in copper pyrites.

Ferrous sulphate oxidizes easily to ferric oxide and free sulphur; but the higher sulphides do not.

Ferrous disulphide is a very inert substance at ordinary temperatures. It possesses the same composition as iron pyrites, FeS_2, and only oxidizes very slowly. In presence of water vapour, it gives two-thirds of its sulphur as sulphate, and the remainder as free sulphur. When the temperature of oxidation is raised, the action is much more rapid. Thus you are able to convert the sulphur of hydrogen sulphide into sulphuric acid in one operation. The sulphides of the Fe_nS_{n+1} series also oxidize chiefly, if not entirely, to sulphate under suitable conditions.

The question at once arises, Is it not possible to convert a relatively large quantity or all of the sulphur into sulphate? It would obviously be a great advantage to do so, as the sulphate of iron so formed, even if it was not sold as such, could be converted into sulphate of ammonia and residue of iron oxides suitable for further purification. While work is proceeding on these lines, it can be safely stated that, with a certain quality of ferric oxide, and at higher temperatures than those usually employed, and in the presence of steam, such a process is quite feasible.

The sample of ferrous sulphate shown has been made directly in the way indicated, and was taken from a batch of about 40 tons, which consisted very largely of ferrous sulphate. The process could be very conveniently introduced where the oxide box follows a sulphate of ammonia plant for purifying the waste gases. Here the conditions of temperature and admission of steam are easily controlled. The application of the process to coal gas purification would necessitate careful control of these conditions; but it is probable that the purifying area could be greatly reduced. The advantage of not requiring ammonia in the gas and the removal of the chief product in solution would give more continnous operation.

At all events, you will see that the possibilities of oxide purification have not yet been exhausted, by a long way.

DISCUSSION.

The PRESIDENT (Mr. H. E. Bloor) said Mr. Weyman had given them a very good paper. He was sure it would well repay study.

Mr. H. H. BAGSHAW (Sunderland) referred to the difference between the working of Dutch bog ore and burnt oxide. Recovered oxides did not seem to give nearly the good results that were obtained from Dutch bog ore. He would like to know if the use of steam gave acid in the oxide, and what steps Mr. Weyman would advise to deal with back-pressure in recovered oxide.

Mr. A. ERNEST RUFFHEAD (Darlington) said steam acted on the free sulphur deposit, forming sulphuretted hydrogen and oxide. Did this occur to any extent in the ordinary purifier? They had an arrangement by which they introduced steam into the boxes.

Mr. WEYMAN, in reply, said he was anxious not to create too much discussion, because he had promised a second paper to the auxiliary section. The figures in regard to the working of bog ore and burnt oxide were in keeping with what most people had experienced. It was very usual with bog ore under ordinary conditions to get up to 50 p.ct.; while burnt oxide required more changes. The density of burnt oxide was greater. Ultimately they passed more gas through their boxes before they could accumulate 50 p.ct. of sulphur; and when turned out they had more than the equivalent of bog ore. The great remedy for preventing back-pressure was never to let the oxide dry too far and then wet it again—it should always be kept with a certain amount of moisture. In summer conditions it was usual to advise steam being put in for this purpose. As a general rule, burnt oxide had to be worked at a higher pressure than bog ore; and he should think that any difficulty experienced with burnt oxide was due to working it at too low a pressure. The oxidation was slower, too; and it was possible to accelerate the oxidation by increasing the temperature. It was really advisable to work burnt oxide under acid conditions. At his works they had been working for a long time under acid conditions.

CHURCH LIGHTING.

Paper before the Illuminating Engineering Society.

In a paper which he read before the Illuminating Engineering Society on April 20, Mr. John Darch gave the following rules for church lighting: (1) The lamps to be so placed that they do not occupy the field of vision. (2) The illumination should be sufficient, and so arranged that the objects shall appeal readily and truthfully to the eye, so that perception may become a real pleasure. (3) The illumination in the pews should be sufficient in intensity and convenient in direction. (4) The colour of the light should approach white, as nearly as may be obtainable. (5) Separate local lighting should be provided for the pulpit and wherever the general lighting is insufficient. (6) Provision should be made to subdue the general illumination during the sermon, or when required.

Discussing methods of lighting, he said that overhead direct lighting from ceiling or roof may be concentrated in a few units or distributed over many points. In overhead lighting, we take a leaf out of the text-book of Nature. Such lighting illuminates the whole interior more naturally, and affords good visibility and freedom from glare. It is particularly appropriate to churches with panelled and other ceilings; but the character of any installation would always be governed by the design of the ceiling or roof.

One of the best devices for overhead gas lighting is the ventilating sunburner. The older type of open-flame burner has already been in use in a number of churches, and was found costly; but the modern types, which employ clusters of small, and therefore durable mantles, give as much as from 650 to 1000 c.p. for only 20 c.ft. of gas per hour. In the North, many Gothic as well as other styles of churches are using them. Arrangements can be made for lowering the burners; and access is facilitated when there is a roof-space directly over the ceiling. The half-watt electric lamp could, of course, be economically employed in the same way.

It is important in any kind of overhead light that the lights do not come within the angle of view. The eyebrow angle is 25° to 30°; but it might in these cases be extended to 35°, or even the foremost unit might be shielded so as to preserve this angle. Concealed direct lighting, in which lamps are placed behind arches, window reveals, columns, &c., and are not visible from ordinary points of view, will be available in most Gothic churches. The chancel calls most loudly for concealed lighting, with its improved visibility and charming effects.

Indirect lighting from opaque bowls, containing concealed lamps and reflectors, is best suited to churches with light-coloured domes, vaulting or other expansive ceilings, and light upper walls. As the reflective power of these surfaces is an essential factor in the illumination, they should not be allowed to get too dirty. Its characteristic is its natural overhead illumination; and its advantages are its agreeable diffusion, its power of softening, without destroying, the shadows, and particularly the high visual efficiency that is possible with it. It is said to be less efficient per lumen generated than direct lighting; but the above advantages, combined with the possibility of using powerful and economical lighting units, should compensate for loss in absorption. It has, however, been used where direct overhead lighting would have been better. Indirect lighting from concealed positions can be used only in churches whose architectural features are adapted to it—such as suitable cornices, clerestory and other high window sills, the tops of screens, and columns, &c. A possible objection would be the risk of great inequality of illumination. In considering the various alternatives, there is, of course, no reason, should the case demand it, why combinations of the methods should not be adopted, providing unity of design in the lighting is not impaired.

RECENT EXTENSIONS AT THE DARLINGTON GAS-WORKS.*

By A. Ernest Ruffhead, A.M.Inst. C.E.

[A Paper read before the North of England Gas Managers' Association, May 1.]

In giving what seem to me some of the most interesting points in connection with extensions at the Darlington Gas-Works, I trust I shall promote a profitable discussion and induce members to tell us how similar problems with which they have been confronted have been overcome, or how they would suggest alternatives. I have purposely omitted a good deal of information in the hope of eliciting questions.

The Darlington Gas-Works occupy three of the angles formed by the North-Eastern Railway (originally the Stockton and Darlington line) crossing the River Skerne over a bridge, designed and built by George Stephenson, over which the first railway passenger train passed on Nov. 27, 1825.

The works on the south side of the railway embankment, on both sides of the river, proving inadequate, a site was purchased on the north side, part of which (where stand the present retort-house and coal-store) was a slag-bank some 25 ft. high—the top about level with the adjacent railway sidings. This slag was removed about 17 years ago, crushed, and after putting in concrete foundations using it as aggregate, the remainder was sold. It was not, however, until 1913 that the present development was commenced.

A scheme was prepared for a complete gas-works on the new site; but so far our extensions comprise only railway sidings, coal-store with gantries, a 2-million per diem Glover-West vertical-retort-house, with coal and coke handling plants, condensers and tar and liquor tank. The gas, after leaving the condensers, travels a considerable distance to the existing exhausters and purifying plant on the south side of the railway.

General.

Among the principles aimed at in carrying out the works were the following:

All materials and workmanship were the best of their respective kinds. The cost of inspection to ensure this has been more than repaid by the results obtained.

All foundations were of ample size, carried down (wherever possible) on to natural subsoil; thus relieving us of any future anxiety on the score of settlement.

Every advantage was taken of the peculiarities of the site to ensure economy in working and handling material.

So far as reasonably possible, duplicate plant of ample capacity and alternate methods of handling have been introduced, so as to reduce the chances of breakdown to a minimum; and in many an anxious moment during the war we have had cause to congratulate ourselves that we were able to "carry on" with the minimum of labour without being unduly dependant on the vagaries of the machine.

Practically, all our gas has been made in this plant during the past 5½ years; our horizontal retort-house, with the De-Brouwer stoking machinery, being only occasionally required in the depth of winter. The provisions we have made have generally fully justified themselves. I, therefore, have the more confidence in giving you some account of them.

Coal-Handling Plant.

The coal-handling plant includes the high-level railway sidings with 40-ton weighing machine, coal-store with two lines of railway gantries, breaker pit at each end, duplicate elevators, and push-plate conveyor delivering into the row of coal-hoppers above the vertical retorts.

A 10 in. tank locomotive deals with all the traffic; the weight of every truck being recorded by a ticket punching apparatus on the machine, which tends to eliminate error. The coal-store holds 3000 tons of coal, and can be filled practically without trimming; the gantries being 26 ft. 6 in. above the floor-level, which is also the retort-house floor-level. The store is divided into three by two steel-framed partitions, filled-in with expanded steel concrete, to assist in isolating a fire should one ever occur. At intervals, 1 in. wrought-iron tubes are fixed vertically from the floor to the gantry-level, plugged-up at the top except when, periodically, thermometers are let down to ascertain the temperature of the coal at various levels. This has never been found to be above 85° Fahr.

The retort-house is alongside the coal-store; and at either end of the latter is built a steel inspection chamber, over the breaker pits, with entrance from the retort-house. Through sliding doors in each chamber coal gravitates into the small hopper over the breaker feed-tray, and, with normal deliveries, it is not necessary to trim. One inspection chamber has a lean-to roof; but in the other the steel sides are carried up to the railway level, forming sides of a 65-ton hopper within the chamber, with bottom door and shoot discharging on to the same small hopper over the breaker feed. Thus, by closing the chamber doors and using only the hopper which is immediately under the railway gantry, we have every facility for fully testing any particular coal on a scale only limited by the quantity at our disposal, or a consignment can be carbonized in one bed only, over a comparatively long period, and its properties noted.

We have never regretted the decision to instal a second elevator in place of a suggested lift. The latter would have been a questionable luxury, but a poor, if not impossible, alternative as a means of elevating 160 tons of coal per day.

The push-plate conveyor is driven by clutch-gear from either elevator driving the shaft and reversed in direction. By building a platform along both sides, and removing the necessity for climbing over it, we have reduced the risk of accidents, and left the attendant no excuse for neglecting its lubrication.

Each elevator, with the breaker and feed tray, is driven from a separate gas-engine by a series of belt-drives, which, being almost vertical, are rather unsatisfactory, owing to the necessity for keeping the belts very tight. But the arrangement has an advantage. All is not coal that comes from the collieries nowadays, and, in addition to a goodly proportion of dirt and stone, we often find the weight made up with pit props, sprags, shovels, pickheads, pinch bars, sling chains, &c. When one of these gets fast in the coal-handling plant, a belt generally gives way first, and prevents worse damage to the plant.

A short description of the construction of the breaker pits may be of interest. The site of the coal-store has been an old brick-yard, filled up some 8 or 10 ft., and in parts the clay had not been removed. Fortunately, the site of one breaker pit proved to be wholly in clay, and caused practically no trouble to construct; the excavation requiring very little timbering. The walls and floor, up to the usual water-level in the surrounding ground, were built of clean gravel, sand, and cement concrete (4 to 1). We filled in behind the walls with clayey material, and no water leakage has ever been seen.

The other breaker pit gave considerable trouble. The excavation was in fine sand, which became water-logged at a depth of 8 ft.; the total depth being 19 ft. An advance sump was formed in one corner of the pit, and a Pulsometer pump was kept constantly at work. Strong, close-boarded timbering was necessary; and as the excavation proceeded, running sand was encountered. The utmost difficulty was experienced in getting out the last foot. As fast as the sand was excavated, more sand bubbled-up with the water all over the site or ran in under the boarding. As this was undermining adjacent foundations, it was decided to leave in the last inch or two, and after forming a wood-framed sump, filled with broken slag, under the pump suction, we decided on the expedient of covering the whole site with strong canvas, such as is used for outside shop blinds. On this was spread a 6 in. layer of clean broken brick and slag. The canvas kept the sand quiet while the water, which came through and from behind the boarding, found its way to the sump. A little finer slag now being spread on top, a 6 in. layer of concrete was spread above this. The porous underlayer of slag was found quite satisfactory, and—the pump dealing with the water as it gathered—the concrete set in due course. The rest was comparatively easy. A half-brick wall was built all round the outside of the pit, as close as possible to the boarding; and natural rock asphalte, ¾ in. thick, laid on hot, in two coats, was used as an impervious rendering spread over the concrete and up the sides of the walls.

A 20 in. concrete floor (4 to 1) was then put in, strengthened with layers of old rails, steel tees, and rods. Shuttering to form the inside of the pit was now fixed, and the concrete walls built. The greatest care was, of course, taken to keep the water down to the slag level. The 4½ in. wall was built around the pump suction pipe, leaving it outside; the width of the pit wall on that side being 5 ft., giving us ample room to do so. When the pit walls were sufficiently set and well above the water-line, the pump was removed and a 12 in. cast-iron pipe placed vertically into the sump. For a foot or so broken slag was piled round it, and the hole then filled with concrete; the pump suction being dropped down the 12 in. pipe, and the water kept down until the concrete set. A right-angled bend was fixed to the top socket of the vertical pipe, above the usual water level, bringing the suction hole or well to the outside wall of the breaker pit in an accessible position. Should the pit have been found to leak, the well would always have heen useful to keep the water down while endeavouring to repair.

I am pleased to say that the pit, with its heavy concrete walls and superstructure, on a foundation of running sand, loose slag, and canvas, has never shown the least sign of settlement or leakage. Curiously enough, quite recently the drains on the railway embankment became blocked, and the surrounding ground was water-logged. The water, not finding its way to the river quickly enough, rose above usual level, and began to pour out of our "safety-valve" pipe, causing some inconvenience, but proving that the conditions at the bottom of the breaker pit remained as they were left over six years before.

Retort-house.

Our 2-million Glover-West continuous vertical retort-house is of the usual type, in eight beds of eight retorts, of what I believe is now the standard size of retort, but not quite the latest type of setting. We have, however, always been able to maintain good, even heats; and although we had difficulties at first in carbonizing Durham coal, these have been overcome.

The producers are filled by a small coke-skip, which after being loaded at the spout of a coke-hopper, passes over an automatic

* An illustrated article in the "Journal" for Nov. 24, 1914, gave some particulars as to certain of the extensions at the Darlington Corporation Gas-Works, now further alluded to in Mr. Ruffhead's paper.—Ed. G. J.

weighing machine, where its weight is recorded on a tape by the attendant lifting a lever. At the same time a counter registers the number of loads, checking the man; and thus we know the actual weight of coal used, and even the number of skips of fuel put on the beds under fire are counted and noted down by the filler. The producers have stepped grates, and are pricked-up and the clinker worked-down every four hours. False bars are not required, which is really a great economy. We have always insisted on the stokers nearly closing the producer main dampers before opening the doors, so as to prevent a rush of producer gas to the settings. Recently we removed the doors altogether from one producer, and, by adjusting the main dampers, have been able to maintain the heat of the bed quite as well as before. Possibly the advantages of this arrangement, except in the matter of supervision, are not great in our case; but we have not noticed any serious disadvantage.

I may say here that constant supervision is a most important requisite for efficiency with continuous vertical retorts. The average stoker, however willing he may be, seems unable to grasp the serious consequences of small acts or omissions, and so many occasions arise when rule-of-thumb methods do not apply that the need for a man who has sufficient technical knowledge of the principles of carbonization becomes imperative. Of course, such a man is able to train the regular men to a large extent, but there always remains the necessity to be constantly on the watch.

The extractors are driven by one of two duplicate small gas-engines, the other being kept in readiness for work at a moment's notice—each running continuously three or four days per week. In case one should be under repair, we have fixed up an electric motor from our horizontal stoking machinery as an additional stand-by; for the coke extractors must never be allowed to stop more than a few minutes if avoidable. They have never done so in our case, except once a year in the summer for repairs to plant which cannot be bye-passed.

It may be of interest to give the method of procedure when we "cease" gas making. At 5 p.m all chimney dampers, primary air slides, and secondary air dampers are reduced by one-third. At midnight, we commence to reduce the speed of the extractors hourly until, by 5.30 a.m., it has been reduced by a quarter, and at 6 a.m. the extractors are stopped altogether, and steam shut-off the retorts. At 8.30 a.m., the retort-house governor is bye-passed, and the exhauster regulator or governor set to give about 1-10th vacuum on the foul main in the retort-house. The station-meters, jet photometer, and recording calorimeter being now read at frequent intervals, the quality and quantity of gas are soon found to fall off rapidly, and the exhauster is finally brought to a stand (say, about 9.15 a.m.). At each end of the part of the foul main which runs alongside the retort-bench and receives the gas-mains from each bed, we have connected a vertical blow-off pipe carried up through the roof. The valves of these are opened immediately the exhauster is stopped, and they are regulated to maintain a slight pressure on the foul main and the retorts. From that time until we start off again, all the gas made in the retorts is, of course, blown away. Whether we could stand for a long period—say, throughout a Sunday—has never been tried, though I believe it is, or was, the practice in some works. I cannot, however, see that it can be an economical proceeding. It is advisable to run the extractors for a few minutes at intervals, and afterwards have the retorts poked-down from the top, to guard against the coke being permanently hung-up, and to reduce the heats of the settings, which, of course, must be carefully watched. This means more coal entering the retorts and more gas blown away; but it reduces the chance of a breakage in the scurf which would probably necessitate bringing off the retort, when a day-and-a-half must elapse before it can be put on again. Generally, we have been able to get all the retorts away again without one failing. The longest time we have been standing was about eight hours.

The boilers which supply steam to the retorts and producers are fed from an overhead tank of about 2000 gallons capacity, which also acts as a circulating tank for the extractor gas-engines. Thus a supply of warm water is available, utilizing waste heat from the engines and economizing fuel; while, at the same time, cold water from the town main, in replenishing the supply, serves to keep the temperature of the circulating water low.

Coke-Handling Plant.

It is perhaps unnecessary for me to point out that the coke formed in continuous verticals is never at rest long enough to attain the density of that made by the intermittent horizontal or vertical systems. It is therefore friable, and requires very careful handling to prevent undue formation of breeze. The method we employ is to discharge into skips, which are picked-up and transported by means of telphers.

Our coke yard is in front of the retort-house, and down the middle runs the telpher track, at one end of which are a coke receiving hopper, screens, and storage hoppers. At the other end the track continues round the end of the retort-house and over our high-level railway sidings to a telpher shed. From a switch near the opposite end of the retort-house the track also runs at right angles into the house, finishing over a coke-hopper used for feeding the producers. Thus the telpher crosses the longitudinal centre line of the retort-bench at each end. On this line runs a 2ft. 6in. gauge railway, extended at both ends for shunting purposes. Eight four-wheeled bogie-frames, strongly made of steel channels and plates, run on the rails underneath the retort mouthpieces, which are four in a row, all discharging towards the centre. The bogies are propelled by means of an endless steel wire rope, running in an underground channel. By throwing over a weighted lever an attachment on each bogie can be made to grip the travelling rope, or by simple reversing gear it will grip the returning rope. Thus the bogies can be made to travel in either direction, and the speed of travel, which is less than walking pace, is such that a workman is unlikely to be trapped before he can get out of the way.

A 4 H.P. electric motor is provided to drive the drum around which the rope is wrapped at one end. At the other end is a tension arrangement. The rope passes over small pulley wheels attached to each bogie, and when the grip is off one man can easily push a load. The rope has only been renewed twice in 5½ years, and the other repairs are trifling. Resting in the bogie frames are steel coke-skips, made to hold the discharge from four retorts (about 14 cwt.). They are fitted with trunnions to take the telpher lifting bale-hooks, and are so balanced that the telpher driver, by pulling a rope actuating a releasing lever, can tip a loaded skip, which will right itself when empty.

The coke drops into skips immediately below the mouthpieces, and is not touched again until discharged at any required point on the coke heap, on the screens, in the producer feed hopper, or in railway trucks; being lowered by the telpher immediately over the positions in which it is required to be deposited. The formation of breeze is thus reduced to a minimum.

The telpher is also used for loading coke, ashes, and sometimes stock coal from the yard into railway trucks, besides dealing with incoming material from our sidings. Its track rail is 50 ft. high above ground-level; and a heap of coke 40 ft. high and 100 ft. wide can be stored along its full length in the coke yard.

For this plant the town electric current is generally used with our gas-engine and dynamo (which were originally installed for the horizontal stoking machinery) connected up as an alternative supply.

Here, again, two telphers were provided, so that one can be used for yard work, such as coke loading, independently of the retort-house work. Both are, however, available for the latter; for, while the coal extractors must never be standing, a means of dealing with the coke every two hours must also be available. During threatened air-raids (the town current being shut off), it was often necessary to have recourse to our generating set; and had the enemy ever been very near, we should have been obliged to stop the gas-engine. We therefore erected near the rope-way a 1-ton hand-crane, with a sling made to lift the coke-skips. It is necessary to use each skip twice every round; and the first load must therefore be dealt with without delay.

Condensers.

After leaving the retort-house governor the 24-in. foul main is carried twice along the north wall of the retort house, falling rapidly, before entering the condensers. These are a pair of 1-million vertical water-tube type worked in series by means of four-way inlet and outlet valves, which allow of nine different directions of flow.

Our practice is simply to reverse the flow each morning, so that the inlet of the first condenser becomes the outlet of the second. By a similar arrangement the water supply can be reversed in flow—always, of course, being made to meet the cooler gas first. After leaving the condensers, we utilize the larger part of the hot water by tapping the overflow and carrying it to the producers, also to tanks for coke-quenching purposes.

The efficiency of a water tube condenser depends to a large extent on the inlet temperature of the water; and when, in the summer, one finds the town's water at 62° Fahr. it is a matter of impossibility to reduce the gas, probably at an inlet temperature of 160° to 60° Fahr. at the outlet of the condenser, no matter what amount of water is available. The condensers should, therefore, always be designed on the large side, with water connection of ample size, as the speed of flow can always be reduced if necessary. Fortunately, we are in the position of being able to pass our gas, after leaving the new works, through a long length of main and before reaching the exhausters, through our existing batteries of annular condensers. Except in the very cold weather, therefore, these are brought into use, and the outlet temperature of the water-tube condensers is regulated to about 85° Fahr., saving a large quantity of water, besides improving the quality of the gas by less rapid cooling.

Tar and Liquor Tank.

After considering the merits of various materials, we decided to construct our tar and liquor tank of cast-iron segments. It is 50ft. diameter, 11ft. deep, divided unequally by a cross partition. Within it, adjacent to both parts, is a receiving tank or separator, from which the liquor flows over an adjustable weir with scum plate, into the liquor tank—the tar outlet being a sealed pipe.

A number of cast-iron stancheons support steel joists to carry the tank top, which is constructed of expanded steel concrete, entirely covering the steel joists to prevent deterioration. After completion, the underside of the concrete was given two coats of cement wash.

The excavation for the foundation was 51ft. 6in. in diameter and 16ft. deep; and, in the ordinary way, very heavy and expensive timbering would have been required. This was got over by forming the walings into a polygonal frame of twenty pieces, bolted together at their radiated butted ends with steel plates. The

waling pieces consisted of two rows of 11in. by 3in., spaced 2in. apart. They were found to answer satisfactorily; thus doing away with all necessity for struts, and giving a perfectly clear space for the erection of the tank. It was anticipated that water would be met with, and close timbering was used of 7in. by 2½in. boards with V-joints.

It was soon necessary to instal a pump, with suction close to the side of the excavation. As the river runs alongside the works, all water-bearing strata become water-logged below a certain depth. Fine sandy subsoil was again encountered and two or three strong springs of water which caused a lot of trouble. Eventually the bottom of the excavation was reached, the nature of which improved—being clay and sandy clay. A sump was made for the pump suction; and a ring of agricultural drain pipes was carried right around the outside of the excavation to the sump. Twelve inches of concrete was put in over the whole site; a layer of heavy section expanded steel being placed at a height of 4in. from the bottom.

As there appeared to be no diminution in the springs of water, which had evidently been making their way to the river before being intercepted, it was eventually decided to lay a deep 6in. drain from the agricultural drain to a spot as far down the river as would give a good fall. This was a rather expensive affair, but has ensured that there shall be no likelihood of a high pressure of water, added to the earth presssure, against the side of the cast-iron tank. Until this drain was finished, the greatest care had to be taken to keep the water down to prevent the possibility of the tank floating off its foundations. This deep drain is examined periodically at the manholes, and found to be running quite freely—in fact, the water is now tapped, pumped to an overhead tank, and used on the works for the condensers, &c.

In conclusion, I wish to express my indebtedness to my chief, Mr. Frank P. Tarratt, for his permission to give these details. I trust they have proved of some interest.

DISCUSSION.

The President (Mr. H. E. Bloor) said he well remembered that, shortly after the works at Darlington were finished, he had the pleasure of going over them with Mr. Tarratt, and finding that they had been well thought-out and fitted-in with the general scheme. It was a very satisfying job, and one which he thought they could congratulate Mr. Tarratt on having successfully completed.

Mr. C. Dru Drury (Sunderland) said he congratulated their Darlington friends upon the way the geographical features of the site had been tackled in order that the works might be arranged to the best advantage. He spoke approvingly of the manner in which raw material was handled, particularly in regard to the facilities for dealing with any particular run of coal which they wished to try. The want of this had been a drawback at the speaker's works. If he had the designing of works again, he would endeavour to arrange some such contrivance as would maintain and test, in a practical way, about 100 tons of coal or more at a time. He once went into the question of slag when about to construct an underground concrete tank for liquor. He tested several samples, and found a large excess of sulphur in some cases. The only slag that seemed suitable was from steel works; and it was so excessive in sulphur that he decided to do without it. The ordinary slag was too sulphurous to use. They could sympathize with Mr. Ruffhead in his troubles with the coal-breaker. They all had similar experiences. At the speaker's works, they had had experience of so damaging their breakers and engine that they had had to resort to the direct driven engine, without belts. Since then, in common with other works, they had been practically immune from damage to coal-breakers.

Mr. F. H. Robinson (Harrogate) said that, in regard to breeze, they found a considerable difference between vertical and horizontal retorts. As a test, they took a ton sample of different coke and treated it in the same way; and they found the amount of fine dust from the vertical coke was double that from the horizontals—6 p.ct. from the horizontals, and 13 p.ct. from the verticals.

Mr. T. Hardie (Newcastle-on-Tyne) said at his works, they had similar settings to those at Darlington; and he could bear out what Mr. Ruffhead had said as to working results. They had always used Durham coal; and he could not say what could be done with other classes of coal. The results obtained from vertical retorts had shown that it was not the big classes of coal that were at fault. Durham coals went through all the usual vertical retorts just as Yorkshire coals did, although there were some kinds of Durham coal more difficult to carbonize, because it took very high heats to drive off the gas. If the temperatures were maintained, there was no difficulty in carbonizing Durham coals quite properly. The trouble arose when men used to Lancashire or Yorkshire coal got Durham coal to use. The firing was different; and a man must get used to doing the kind of firing that was suitable for Durham coal. They could get a make of gas on the vertical retorts with Durham coal almost equal to that obtained with Yorkshire coals. One interesting thing in the designing of the Darlington works was the very considerable depth of coal stored; and he would like to know if they ever stored coal to the full depth of 26 ft. If they did so, they were very very fortunate in storing Durham coals to maintain the temperature so low. In the plan of the works, considerable judgment was quite evident; and the manner in which difficulties with the ground had been dealt with showed that much forethought had been exercised in the foundations. One of the greatest difficulties he had found in foundation work was in overcoming those concerned with running sand and water. He had had this difficulty at his own works; and a serious one at Darlington seemed to have been very successfully overcome.

Mr. Ruffhead, replying to the discussion, said, with regard to the slag, they only used it in heavy concrete walls, and found no detriment by it so far as he could see. Where they had used extended steel, the concrete was made of gravel, and did not contain slag. They had found a certain amount of sulphur in the slag; but he did not know that there had been detriment in using it. There was a guarantee to get a through-put of 2 to 10 cwt.; and they had maintained this. The make per ton had always exceeded the guarantee. Their men were trained to shut the dampers every time the fires were being cleaned. If the men could not be fully relied upon to shut the main dampers when cleaning fires, then some contrivance was needed for the purpose. The coke was more friable in vertical retorts. Their coal-store for about four years remained full within 3 ft. of rail level, or 23 ft. 6 in. of coal. They kept at this amount of storage until the Coal Controller said they must have less coal; and then they transferred some of it to Mr. Robinson. [Laughter.]

THE WOODALL-DUCKHAM SYSTEM OF CARBONIZATION IN CONTINUOUS VERTICAL RETORTS.

By W. Temple Gardner, Chief Chemist to the Woodall-Duckham Company.

[Address delivered on May 1 before the Scottish Junior Gas Association (Eastern District).]

Principle of the System.

In common with other systems of continuous vertical retorts, the principle of the system consists in carbonizing coal in a suitably constructed and heated vertical retort.

Description of the System.

The coal is heated as it descends, and the various gases and bye-products are evolved as the coal reaches the necessary temperature. The gases ascend and are taken away from the top of the retort. Thus the process is really one of fractional distillation. The speed of travel is regulated so that the coal entering at the top is gradually carbonized in its passage through the retort, and is converted into coke by the time it arrives at the bottom. The heating is most intense around the upper part of the retort. Consequently, the heat necessary for carbonization is applied where it is most readily absorbed, and the temperature gradient across the retort wall is at the maximum. The amount of coal fed into the retort, and the rate at which the charge descends, are both automatically governed by the speed of extraction of the coke from the bottom of the retort. The construction of the retort is of the simplest form. The sight-hole at the upper end of each vertical heating flue makes it possible to examine the heats and the condition of the whole retort from the top platform.

Size and Capacity of Retorts.

The retorts are about 25 ft. long, and of rectangular tapered shape. The three sizes (of 3, 5, and 7 tons a day capacity) vary practically only in the length of the major axis; the minor axis in all cases being 7 in. at the top and 1 ft. 7 in. at the bottom.

Below are given particulars of the three sizes of retorts:

Size.	No. 1.	No. 2.	No. 3
Breadth and width of retort at top	2 ft. 10½ in. by 7 in.	4 ft. 3 in. by 7 in.	5 ft. 1½ in. by 7 in.
Breadth and width of retort at bottom	4 ft. 3 in. by 1 ft. 7 in.	5 ft. 3 in. by 1 ft. 7 in.	6 ft. 6 in. by 1 ft. 7 in.
Length	25 ft.	25 ft.	26 ft.
Coal carbonized per day according to class of coal in use	2½ to 3½ tons	4½ to 5½ tons	6½ to 7½ tons
Average yield of gas per retort per day	30,000 to 40,000 c.ft.	60,000 to 70,000 c.ft.	80,000 to 90,000 c.ft.
Number of retorts per setting	Three to five	Two or four	One*

* Each 7-ton retort is a self-contained unit.

The taper of the retort is not even from top to bottom; the majority of the taper being confined to the upper 10 ft., where the maximum swelling of the coal takes place. The actual width of the retort on the minor axis increases from 7 in. at the mouthpiece to 1 ft. 4 in. at a point 10 ft. down. The combination of this exaggerated taper with the existence of the high combustion chamber temperatures at the top of the retort enables the most sticky and strongly swelling coals to be successfully carbonized without undue trouble.

It is an undisputed fact that, in order to carbonize strongly caking coals in continuous vertical retorts, it is absolutely necessary to work with high temperatures at the top. The maximum working temperatures in the combustion chambers are usually about 1290° C. (2354° Fahr.) at the top and 1000° C. (1832° Fahr.) at the bottom; but these temperatures may be varied up or down somewhat to suit special circumstances.

Construction of Retorts.

The walls of the retorts are formed of bricks tongued and grooved so that leakage at the joints is prevented, and panelled-out at the back so that the heat can readily pass through the walls to the charge in the retorts, and a large surface is presented to the heating gases in the flues. The retort wall bricks measure 4½ in. from front to back; but, owing to the existence of the panels, the average thickness of fire-clay material through which the heat has to travel from the combustion chamber to the charge of coal is a little over 3 in. In this way a retort wall is formed

practically equal in strength to a solid 4½ in. wall, but having a heat conductivity equal to that of an ordinary 3 in. solid retort.

Heating Arrangements.

The heating flues are vertical, and the division walls separating the flues are constructed of tongued-and-grooved bricks. The division walls are bonded into the walls of the retorts and into the back walls of the flues, thus forming a very strong and simple construction.

The producer gas and secondary air are brought to the top of the setting, and are admitted at the top of the vertical flues—combustion proceeding downwards. Dampers for the producer gas, secondary air, and waste gases are provided for the purpose of maintaining safe and uniform heating of all the retorts, the dampers being operated from platforms placed in convenient positions. The three-ton and seven-ton sizes of retorts are built in batteries of six and upwards, and are provided with outside producers situated at the end of the retort-bench. Five-ton retorts are arranged in settings of two or four retorts, complete with producer and regenerator in each setting. Each seven-ton retort is a self-contained unit, with its own regenerator situated at the lower end of the retort.

Producers of the step-grate type are now installed. These only need pricking-up; no clinkering being necessary.

Until about six years ago, the five-ton retort was the only size in use; but it was then found that a demand existed for both smaller and larger sizes. Consequently, three-ton and seven-ton retorts were designed to meet the requirements of small and large works respectively. For small works, with a daily output up to about half-a-million cubic feet of gas, retorts of three-ton or five-ton capacity are installed; for medium-sized works, up to about two millions per day, the retorts are usually of the five-ton size; while for larger outputs, the seven-ton size offers many advantages. On the smaller plants lifts are provided for handling coal and coke in skips to the overhead bunkers; for larger plants, bucket elevators or conveyors are installed for this purpose.

Details of Settings.

Top Mouthpiece.—At the top of each retort is a cast-iron mouthpiece, to which is attached the coal-feeding device and the gas off-take. A gas-tight auxiliary coal hopper, constructed of mild steel plate, and having a capacity of from two to four hours' coal supply, is mounted on a special casting attached to the mouthpiece. The casting is so formed that the hopper in no way obstructs free access to the retort for inspection, scurfing, or filling with coke.

Coal Valve.—At the top of the auxiliary hopper is fitted a circular gas-tight coal-valve, which is operated by hand every two, three, or four hours. The time required for this operation is about ten seconds. This coal-valve is of simple design, and practically consists of a cast-iron plug cock with an opening about 9 in. square.

Coal Indicator.—The speed of travel of the coal into the retort is clearly shown by a special form of gas-tight coal indicator, which is operated by a weight resting on the coal in the auxiliary hopper.

Gas Off-Take.—The gas off-take pipe is of ample area, and is so arranged that it can be readily cleared. The gas passes from this pipe through a seal-pot; and the heavier tars are deposited by fractional condensation before the gas reaches the foul main.

Gas-Valve.—Each retort is provided with a special form of disc valve, the surfaces of which, under all conditions, are kept clean, and which, when closed, cannot leak. This enables each retort to be shut-off for scurfing when required.

Seal-Pot.—Each setting is provided with a seal-pot serving two or more retorts, through which a stream of tar is passed in order to dissolve the heavier tars. The gas, however, does not pass through a liquid seal.

Coke Extractor.—This is one of the most important parts of any system of continuous vertical retorts, as the working of the charge through the retort depends to a great extent upon the efficiency of the coke-extracting gear. The coke-extracting device is fitted at the bottom of each retort for regulating the discharge of the coke. It is situated along the bottom of a curved plate which forms the back of a cast-iron hopper attached to the bottom of the retort. The curved plate takes the weight of the charge in the retort, and the manhole and inspection holes in it provide free and immediate access to the retort. As it rotates, the extractor roller does not shear the coke, but merely allows a definite amount to pass over it into the receiving hopper. Cast-iron hangers are swung from the shaft above the extractor which prevent any coke passing over the extractor unless regulated by the action of it.

The extractor roller is formed of a series of cast-iron cross-pieces mounted on a square shaft, each cross-piece having a slight lead on its neighbour, so that a roller is formed with helical blades. This construction ensures that the discharge of the coke is the same throughout the whole of the revolution of the extractor roller, and therefore the travel of the charge through the retort is constant. The shaft of the extractor roller projects through a gland in the side plates of the bottom castings, and on one end is fitted a wheel having a V-shaped groove turned in the rim. In this groove works an eccentric wedge-shaped pawl actuated by a rocking arm, the travel of which is varied by regulating a screw adjustment. The normal speed of this extractor is one revolution in 60 to 70 minutes; but the screw adjustment allows of considerable variations fast or slow from the normal. The slow speed of the extractor roller, coupled with the fact that very little power is required for driving it, ensures the minimum cost for maintenance.

In case of a breakdown of the gas-engine or electric motor driving the extractor gear, the extractor can easily be turned by hand. The amount of power required to drive the coke extractors for a plant producing one million cubic feet of gas per day does not exceed one horse power.

Reciprocating Driving Bar.—The rocking arms previously described are coupled by short connecting rods to a reciprocating bar running the length of the bench of settings. Each reciprocating bar is driven by an adjustable eccentric fixed to the main driving shaft; the speed being about one complete stroke per minute, and the maximum length of the stroke about 4 in.

Coke-Hopper.—Below the coke extractor is fitted a cast-iron receiving hopper, which is constructed to contain two to four hours' discharge of coke.

Water-Sealed Coke Discharging Door.—To the bottom of the coke-hopper is fixed a water-sealed gas-tight door. It has been found in practice that any form of faced door rapidly wears away and allows leakage to take place when the machined faces are subjected to the combined action of coke breeze and moisture. The construction of this water-sealed door consists of two cast-iron boxes; the one fitting inside the other in such a way that an annular space, which is filled with water, is formed between them. In this space is fitted a segmental door-plate constructed with quadrant ends and suitable bearings and operating wheel. The door is sealed in 4 in. of water when closed. Consequently, it is gas-tight and needs no clamping. The coke is never in contact with the water; but the latter has the beneficial effect of keeping the castings cool. The time taken in discharging the coke from each retort is about ten seconds.

Coke Quenching.—On leaving the retort proper, the coke is finally quenched by a small spray of water playing upon it in the storage hopper. It is, however, discharged practically dry and cold.

Steaming.—On earlier plants, before steaming was in vogue, the heat remaining in the coke after carbonization was utilized for warming the primary air for the producers. Means are now provided for making use of the heat in the coke for the production of water gas; and at the same time the temperatures are increased about the bottom lengths of the retort. Steam is superheated by being circulated through flues situated at the lower end of the retort, and is admitted through a number of inlets in the side walls a short distance above the bottom castings.

The amount of steam introduced to each retort is controlled by means of a metal disc in which is drilled a hole of from ⅛ in. to ¼ in. diameter, depending upon the size of retort and the class of coal to be carbonized. A constant pressure of 30 to 40 lbs. is maintained in the main steam service, which is designed of ample size to ensure each retort receiving the correct amount of steam. Incidentally, Scotch coal in the form of nuts is ideal for the production of high makes of gas by steaming, owing to the rapidity with which carbonization takes place and the depth of incandescent coke available for the decomposition of the steam.

It is interesting to note that, in practice, the total calorific value of the combined coal gas and water gas produced by steaming is always in excess of the value calculated from the individual makes of the two gases at their respective calorific values. This is to some extent probably due to the removal of the last traces of hydrogen and hydrocarbons from the coke, also to the greater carrying capacity of the mixed gases for hydrocarbons, which would otherwise find their way into the tar-well.

The whole of the settings, producers, and regenerators and the various attachments and working parts are usually carried clear of the ground on a steel joist floor supported by stanchions. The coal and coke hoppers are formed in one continuous line along the settings, and are carried by stanchions extending to the floor level. Shoots are provided for feeding the producers, also for filling the retorts after scurfing. The standard capacity of both the coal-hoppers and the producer coke-storage hoppers for all sizes of plants is 48 hours; but larger or smaller capacities can be arranged to suit special requirements. Platforms are provided along each side of the top of the settings, at the producer level, and at the top and bottom flue levels, for cleaning purposes.

Owing to the system of downward heating, with the greatest temperature near the top, all repairs are carried out from the top; the lower portions of the settings remaining in good condition for an indefinite period. On one plant constructed on this system, and situated within easy distance of the City of Edinburgh, a considerable number of retorts are in existence which were put to work in November, 1914, and have never so far been shut-down for any purpose, and even now do not require repairing—a matter of nearly 2000 working days. I mention this to show the possibilities with regard to the life of continuous vertical retorts where, as in this instance, the plant has received proper supervision, and has been run on the right lines.

Waste-Heat Boilers.

On the larger plants, waste-heat boilers are installed to recover the heat contained in the waste gases from the settings. The amount of steam which can be produced in this manner amounts to about 2 lbs. per 1 lb. of coke consumed as fuel in the producers. Thus a plant having an output of one million cubic feet of coal gas per day would produce 20 tons of steam per day from the waste heat—assuming a fuel consumption of about 12½ lbs. of coke per 100 lbs. of coal carbonized. The problem of generating steam

from the waste heat of small installations of vertical retorts having an output as low as ¼ million cubic feet per day is now under investigation; and it is anticipated that in the near future it will be possible to instal small boilers to generate from 400 to 500 lbs. of steam per hour from plants of the capacity mentioned.

Chief Points in Favour of Continuous Verticals.

The yields of both gas and B.Th.U. per ton of coal are increased.

The residuals tar and ammonia are increased.

The output of gas per unit of ground area is increased to, approximately, twice that from horizontal retorts.

A considerable saving of coal is effected.

The gas is practically free from naphthalene.

Sulphur compounds in the gas are considerably reduced.

The heat in the coke, which to a great extent is wasted in the intermittent vertical, inclined, and horizontal systems, is recovered.

Any class of coal can be carbonized.

Economy in fuel consumption is effected.

There is an absence of trouble with stopped gas off-take pipes.

The conditions in the retort-house are better, and the work less laborious for the men.

The labour costs are reduced.

The system is extremely flexible as to the output of gas, quality, &c.

As a result of the coke extraction being carried out by slowly moving mechanism, wear and tear are reduced to a minimum.

Maintenance costs are low, owing to the long life of the retorts.

The coke made in continuous vertical retorts, being practically dry, is particularly suitable for domestic use.

The process, being one of fractional distillation, the production of undesirable degradation products is reduced to a minimum.

The gas produced is of constant calorific value and specific gravity.

[Coloured drawings were exhibited to illustrate the chief constructional features of the system for all sizes of works; and a few of the special shapes of bricks used in the system were on view at the meeting, in order to demonstrate the construction of the retort and heating flues.]

Continuous Analysis of Gas Mixtures by Electrical Method.

A new form of apparatus for the continuous analysis of gas mixtures by an electrical method depending upon thermal conductivity, is described by Mr. E. R. Weaver and others, of the Bureau of Standards, Washington, in a lengthy illustrated communication which has been published in the American Chemical Society's "Journal of Industrial and Engineering Chemistry." In explanation of the principle of the method, it is pointed out that when a wire, surrounded by a gas enclosed in a space the walls of which are at constant temperature, is continuously traversed by a constant electrical current, the wire rises in temperature until a state of equilibrium is reached, in which the continuous dissipation of thermal energy is equal to the electrical energy supplied. This dissipation of energy takes place in the four following ways: By radiation; by conduction through the connections to the ends of the wire; by thermal convection—*i.e.*, by currents of gas circulating in the atmosphere surrounding the wire; and by conduction through the gas. In case there is a flow of gas past the wire, heat is also carried away by the gas stream. By a proper choice of conditions, all loss of heat except by conduction through the gas surrounding the wire may be reduced to a small portion of the whole. The equilibrium temperature attained by the wire will then depend mainly upon the thermal conductivity of the gas which surrounds the wire—being lower when the gas has a high conductivity, and higher when the gas has a low conductivity. Since the co-efficients of thermal conductivity of various gases and gas mixtures differ widely, the temperature of the wire will be determined by the composition of the surrounding gas. If the wire has a high temperature co-efficient of electrical resistance, its resistance to the passage of a constant current of electricity, depending as it does on the temperature of the wire, will have a value corresponding to the thermal conductivity, and therefore to the composition of the surrounding gas or gas mixture. Inasmuch as electrical circuits are easily arranged for the rapid and very accurate determination or comparison of the resistance of such a wire, the quantitative determination of the constituents in a wide variety of gas mixtures whose qualitative compositions are known, is possible by a simple and exceedingly sensitive method based upon the thermal conductivity of the mixtures.

Council of the Institution of Civil Engineers.—The result of the ballot for the election of officers was declared at the annual general meeting of the Institution of Civil Engineers last Tuesday. Among the members of Council are Dr. Charles Carpenter, C.B.E.; Sir William H. Ellis, G.B.E., D.Eng., of Sheffield; Sir Robert A. Hadfield, Bart. D.Sc., D.Met., F.R.S.; and Sir John F. C. Snell. This new Council will take office next November.

TRADES EXHIBITION AT BIRMINGHAM.

The Gas Department's Display.

The Birmingham Gas Department have an excellent show of gas-consuming appliances, &c., at the National Trades Exhibition at Bingley Hall, which remains open until next Saturday. The display is noteworthy on account of the consideration given to gas equipment in connection with the new housing schemes.

The most novel feature, which should appeal to architects and builders, is a full-sized example of a gas-fire, with flue built in the thickness of the wall. The chimney-breast is rendered unnecessary, thus affording much gain in floor space and effecting great economy in building costs. Another interesting exhibit is the "B.C.G.A." model of an up-to-date modern house—a model of a prize-winning design in a competition organized by the Local Government Board for artizan houses. This model is on a scale of 1-in. to the foot, and is complete in every detail. It is installed throughout with suitable types of gas appliances, embracing lighting, heating, cooking, water heating, and refuse destruction. Full attention is given on the decorative side. The range of brackets and pendants is wide; and much taste is shown in the newest types of silk shades. Modern gas-fires include one fitted in a tiled surround with overmantel complete. There is an all-gas kitchen, with a gas-fire, cooker, and hot-water circulator installed. The last-named is shown in thorough working order, providing hot water for a bath. A geyser is in position, and a gas-heated wash-boiler; while on the other side of the range are gas-heated laundry irons. On the stand may also be seen an up-to-date gas-cooker, with specimens of aluminium ware for use with it. Working exhibits of different types of gas lighting show the candle-power of the light and the hourly cost. By an examination of these different specimens the general public are in a position to realize the efficiency and the economy of the modern inverted incandescent gas-burner.

Advantage is taken of the opportunity to demonstrate the work at the Birmingham Corporation Industrial Research Laboratory. There are samples of the latest types of furnaces necessary in the equipment of hardening shops; and attention is devoted to a furnace working on the "Revergen" system, whereby temperatures up to 1600° and 1700° C. are easily obtained. High and low pressure gas-heated soldering-iron stoves are a feature, together with a fine display of jewellers' equipment in the form of gold and silver melting furnaces, annealing muffles, various sizes and types of blow-pipes, and enamelling furnaces. A new type of gas-heated tube-brazing furnace is exhibited.

There are other exhibits of interest to the gas industry. The Parkinson Stove Company have an attractive display of gas-fires, cookers, and water-heaters; their stand being surmounted with specimens of street-lamps. Messrs. Curtis and Harvey give prominence to the processes involved in the manufacture of their mantles. The general lighting of the hall (which is brilliantly illuminated) is by means of gas-lamps supplied from the high-pressure mains. The visitor's attention, on approaching the hall, is attracted by the magnificent lighting outside by four 4500 c.p. "B.G.D." (Birmingham Gas Department) high-pressure lamps. Inside, the main gangways are lit by 1000 c.p. high-pressure lamps of varying makes; while near the bandstand and auditorium are fitted four 4500 c.p. "B.G.D." lamps, with special screens.

Carbon Black from Natural Gas.

Speaking at a meeting of the Natural Gas Conservation Committee, at Washington, Mr. R. L. Carr declared that carbon black is the cheapest and best known colour base for printing inks, carbon paper, and black typewriter ribbons, and is essential to the finest grade of phonographic records and automobile tyres. It is admitted that the making of carbon black is a wasteful use of natural gas; but no other known pigment is as smooth and free from grit, or has nearly as great covering qualities. Carbon black manufacturers have followed the opening of virgin natural gas fields. This they have had to do, because the short life of all natural gas fields has prevented the making of carbon black in any one field for more than a short period of time. The quality of the carbon black is dependent upon many factors; the higher grades being produced by the consumption of the greatest amount of natural gas per pound of carbon black. Much of the carbon-content of natural gas is not recovered as carbon black; but Mr. Carr pointed out that if larger quantities are taken from the gas it results in an inferior product unsuitable for high-grade work.

Price of Gas Oil.—The past two or three weeks in their market report, the "Petroleum Times" has intimated that, owing to the scarcity of gas oil, there were no official quotations. In the current issue, our contemporary states that "the price has advanced to 1s. 4d. per gallon, but supplies are very scarce."

Federation of British Industries and Fuel Economy.—Prof. Bone, D.Sc., F.R.S., is to act as Chairman of the Federation of British Industries Fuel Economy Technical Sub-Committee, whose activities will be confined at first to the examination of problems specific to gas production and steam raising. It is proposed that the Sub-Committee shall consist of men actually engaged in the specialized study of fuel problems in those works where fuel departments have been set up. A Technical Assistant is to be appointed.

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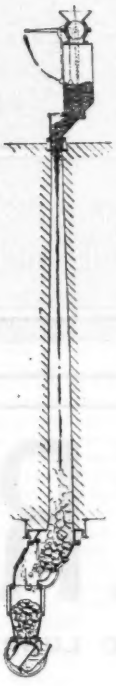

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EASTERN COUNTIES GAS MANAGERS' ASSOCIATION.

Discussion on Mr. Sumner's Paper on "The Distribution of Gas to Outlying Villages."

Completing our report of the proceedings at the recent meeting of the Eastern Counties Gas Managers' Association at Colchester —*ante*, pp. 196-201—we give to-day a report of the discussion on the paper, on the "Distribution of Gas to Outlying Villages," contributed by Mr. Arthur W. Sumner, of Grays—see pp. 202-5.

The PRESIDENT (Mr. W. W. Townsend) said the members had had an excellent paper from Mr. Sumner; and it would form a valuable addition to their "Transactions." Anyone who was contemplating work of this kind would turn to the paper to see how this extensive scheme was carried out, and would get valuable information from it. It had been rendered all the clearer by the excellent map, photographs, and samples that Mr. Sumner had brought with him. He (the President) would like to ask whether he had had an opportunity of making experiments in the delivery of gas at high pressure to see whether the formulæ that were used were correct or otherwise. He should like to ask at what pressure he supplied the consumers where he had a high-pressure main passing their doors, and what was the most advantageous pressure to give. He took it that in the majority of cases the low-pressure distribution to the consumer began at the existing gasholders. Mr. Sumner remarked that "it had been previously found when extending to new districts that approximately 65 p.ct. of the householders would take a supply of gas without undue influence on the part of the Company's representatives." He (the President) should very much like to know what happened when undue influence was used, and how it was managed. [Laughter.]

Mr. F. PRENTICE (Ipswich), called upon by the President, said the only high-pressure system that he had was for street lamps. They worked up to 54 in., and did not supply private consumers. They only lit outside lamps with the high-pressure gas; and the light was exceedingly good—it quite knocked-out any other light produced in his town. Although somewhat expensive, it had a moral effect, which was worth a good deal in these days in showing what could be done by gas if the best possible means were used. The paper was an exceedingly good one; and he was personally interested in it, because he had a little to do with a small works.

Mr. GEORGE HELPS (Nuneaton), invited by the President to speak, said this was a matter in which he was personally interested; and this made it in the circumstances all the more difficult for him to say anything. He was only there to support his friend, Mr. Sumner, and to render him, if necessary, any assistance that he could do in answering any question that might occur. He believed the length of his system worked-out to something like 50 miles. Mr. Sumner seemed to have expected difficulty in welding in branches and anything of that kind. But the difficulties could not be very great, because, when he referred to his wartime experiences, he told them what he did; and he managed to get over the difficulty very easily. He did not refer to any difficulty in the paper that was insurmountable. Welding or connecting under pressure was, as Mr. Sumner said, a little risky. But it only meant care; and then almost any welding could be done under any reasonable pressure—say, up to 10 to 15 lbs. With regard to the question of rust, this was due very often to pipes being left about in damp weather, and so on. When the high-pressure system had been in use for some time, and opportunity was taken to blow-out the stuff, difficulties did not occur again for a considerable period. This was, he thought, Mr. Sumner's experience. Mr. Sumner had stated that he was now supplying gas at about 10 lbs. pressure. He (Mr. Helps) thought that he was supplying at a rather higher pressure from the works. Of course, he could go up to 50 or 100 lbs.; and this showed what a volume of gas he would be able to distribute over this immense area by means of high pressure. Mr. Sumner also knew how difficult it was to estimate the costs of compressing, in which connection the elasticity of the system came into force. He did not know for what period Mr. Sumner kept on his maximum pressure; but in the case of a much smaller experience, he (Mr. Helps) had had at Nuneaton, they kept it up to 28 to 30 lbs, for a matter of two-and-a-half hours over the peak. This was very important for anybody considering high pressure, because some people imagined they had to compress all the time to maximum pressure; but they had not. This high-pressure system of Mr. Sumner's was by far the biggest in the country. The members might be interested in what Mr. Sumner had said as to what small pipes would do. At Nuneaton they had about 12 miles of high-pressure main; and these figures were got out about seven years ago: They had 600 yds. of 4-in. pipes; 4700 yds. of 3-in.; 4330 yds. of 2-in.; 1080 yds. of 1½-in.; 7280 yds. of 1¼-in.; 3000 yds. of 1-in.; and 440 yds. of ¾-in. This main supplied 1680 consumers; and the gas sold off the main to March 20 last year amounted to 19 million c.ft. He did not think there was any main in the country smaller than that distributing such a quantity of gas over the maximum or peak two-and-a-half hours at 28 lbs. pressure. With regard to the capacity of mains, nearly all the calculations of which he knew were very much theory; and this was a direction in which they could very well do with some inquiry. When they got a main with several branches off it, they might multiply the discharge by 3, 4, 5, or even 6. Everything depended on the pressure to which they ultimately wanted to go. They had a good margin in pressure, which meant smallness of mains. He hoped the paper would have the effect of introducing much more high pressure into this country than there had hitherto been. In America they were doing far more with high pressure than was being done in this country. Complete gasification was now here, and high pressure was bound to become almost exclusively used.

Mr. B. B. WALLER (Stroud) said he had listened with great attention to, and had thoroughly enjoyed, Mr. Sumner's paper. The preliminary ground had been well covered by other speakers. One point that occurred to him was that a running pressure of 25 lbs. seemed to him to be a pretty good margin for the service pressure being reduced to 10 lbs. for continuous working. This, he took it, was the constant pressure for working all the time; or was it only the maximum for the peak load? With high-pressure systems like this, there was the steam consumption, or other motive power, for creating the pressure. Mr. Sumner might perhaps give them his running costs for delivering gas at this pressure. It would be interesting if he could do so. There were very large schemes in contemplation at the present time for the distribution and delivery of gas under high pressure. In some districts, large supplies of coke-oven gas were being delivered for town purposes under considerable pressure; and the pressure decided upon was a differentiation between the initial cost and size of the main, and the running costs due to the pressure. For a short length of main, perhaps low pressure and a larger size of main was the best; but for a longer main high pressure with a reduced size of main was cheapest.

Mr. J. W. AUCHTERLONIE (Cambridge) said his first remark must be to congratulate Mr. Sumner on having increased his consumption of gas since 1906—that was, thirteen years—by 300 p.ct. This in itself, whatever their opinions might be of high-pressure distribution, warranted the expenditure he went to in getting the increased business. In 1909, he (Mr. Auchterlonie) did something similar to the author's low-pressure system with two villages. These turned out very well indeed. He considered the question of high pressure; but his estimates for putting in high-pressure plant did not warrant him going two or three miles through the town to get to the commencement of the roadway leading to the villages. The cost putting high pressure quite out of court, they laid a 6-in. main. One of the villages last year took 11½ million cubic feet of gas; and another small village in the same area 3½ millions. In 1912, they put in a welded main to a village, which gave them 9 millions last year. They adopted pretty well Mr. Sumner's method; and they used a compressor to test the main. He thought the use of a scarifier to break-up the road, with fifty or sixty men working, would prove an economy. Mr. Sumner said he took powers by Provisional Order; and he should like to know whether he obtained authorization to charge an enhanced price. He saw the first cost of the works was £5254; and the consumption was 7 millions. On this capital expenditure, 10 p.ct. meant 18d. on the price alone. In his own case, they took power to charge an extra 6d. It appeared that this would not be sufficient in Mr. Sumner's case.

The PRESIDENT: How did you supply your villages?

Mr. AUCHTERLONIE: Low pressure. The pressure at the village was a little over 2½ in. At the termination of the old district, the pressure was about 3 in. It was a good idea to have a valve every 1000 yards. In his case they did not adopt a butt joint, but a socket joint. Butt joints would be more difficult to keep in position when welding; and he thought the socket joint would be better for welding, and would keep the joint more secure. He should like to know (if Mr. Sumner could tell him) what the costs of the compressor and buildings were, as well as the cost of running the compressing plant. This would enable those who were considering the matter to form some opinion whether it was better to adopt low-pressure supply or high pressure. He should like to ask whether any failure of the governors in the houses had taken place. Had there been any failure with the high-pressure supply, and escapes or failures in the houses? He did not think very much would happen if the seal blew outside; but in the houses the slightest escape might be a serious matter. In the drawing, Mr. Sumner showed two valves on the service-pipe. He did not know why he had two; and he should like to know whether he had to supervise these regularly to see whether they were lubricated and kept in order. The disadvantages were the costs of the compressors and building. Then there was the increased cost of services; the two valves must cost a bit of money. There was the cost of the governor, which to stand the pressure must be well made. Then there were the running costs; and the costs of lubricating the governors and valves. There was also the risk of accident. He himself might have to adopt high pressure later on; and so he personally thanked Mr. Sumner very much for the paper he had read.

Mr. HELPS remarked that Mr. Sumner had exhibited a ¾-in. pipe, made up of short pieces welded together. This indicated how in these days of high costs, such pipe could be utilized, and be made just as good as new pipe. The author had, he thought, not seen any reason why all service work of this kind should not be welded instead of being screwed. In these days, labour was so high in price and materials so costly, that he did not think there was any doubt about the advantage of welding. If they did away with fittings, T's, elbows, and so on, and if they made these and welded them with oxy-acetylene, they would have a much sounder and much cheaper job.

Mr. P. D. WALMSLEY (Great Yarmouth) said, being a new member of the Association, he was greatly honoured by being called upon to propose a vote of thanks to Mr. Sumner for his excellent paper. One or two things struck him in connection with it. He could not say that he had had any very recent experience of high-pressure distribution; but for about four years he was associated with Mr. Helps, at Nuneaton, in the initial stages of high-pressure distribution in this country. He must first of all congratulate Mr. Sumner on the comprehensive scheme he had inaugurated at Grays. He (Mr. Walmsley) knew pretty well every high-pressure distribution system in the country; but he was not aware of one on such a comprehensive scale as this. He did not know whether it was to the credit of Mr. Sumner or Gas-Distribution, Ltd.; but he saw that seven miles of main were laid in nineteen weeks. This need not be laboured, although it was before the war. He congratulated Mr. Sumner on the progressive policy of his Company. When they came to reckon this comprehensive scheme at present-day costs, would Mr. Sumner have the courage to advise his Directors to go into such an elaborate scheme at the present time? They had had no mention of costs on a scale which would enable them to judge exactly as to the financial aspect of the scheme. Another point which struck him was that there was no mention made of the cost of buying out the several small companies that he understood had been taken over, which, he should say, would mean a fairly considerable item in addition to the total cost of the scheme—upwards of £20,000, which at 10 p.ct. for interest and depreciation would mean close upon £2500 per annum. In regard to these costs, there was the point which he mentioned as to supplying large volumes of gas through small pipes. He (Mr. Walmsley) recollected that at the time he was

at Nuneaton he was responsible for this being done. On one occasion they supplied an old district, containing several villages, and some 2000 consumers through a ¾-in. pipe, and this pipe rattled like a machine gun. [Laughter.] He did not quite appreciate the necessity for the two valves referred to. When at Nuneaton, he (Mr. Walmsley) had something to do with the high-pressure cock described. Why were the two valves and the high-pressure cock necessary? He asked if Mr. Sumner had any experience of the reduction of quality by the condensing-out of the oils. At Nuneaton, he had never had any such experience; but perhaps there were no oils at Nuneaton to condense out. [Laughter.]

Mr. W. S. Venner (Brentwood) seconded the vote of thanks. He asked as to whether there was any effect from made-up soils on these small pipes—whether with the made-up soil any subsidence was likely to take place.

The proposition was heartily endorsed.

Mr. Sumner, having acknowledged the vote, said he should first of all like to get rid of the matter which seemed to trouble the members a good deal—that was, the two valves shown on the drawing. He himself had wondered what they were for. He might say he was indebted to Mr. Helps for some of the drawings. It was much easier for him to get them from him than to prepare them himself. The valve shown near the main was not at all necessary. They did not use the T as shown in the drawing. They employed the clip; and in the paper he referred to the cock. There was a certain amount of risk when they got leakage from anything of this sort; but if there was only a pinhole from which there was leakage, they could see bubbles above the ground, so that they could easily find a leakage. They had not much difficulty. Occasionally on the service-pipes they had difficulty on the pipe itself, but with these pressures it soon made itself known. They must have a cock there. It was a wise and safe plan, so that they could break-down at the main and shut-off the whole thing. As to the question of the vent-pipe. If they looked at the drawing, it would be seen that it was carried outside the house; so that if the mercury seal did blow, the gas would blow outside, and not inside, the house. They had had these seals blow; but the high-pressure gas passing through the governor seal at once found vent. The gas was being delivered at such a pressure that they immediately got information from the consumer; and the thing was closed-down. They did not lose anything like the same quantity they would do at low pressure, because with low pressure a leakage might go on for many weeks, whereas this did not go on many hours.

Mr. Helps: What is your leakage?

Mr. Sumner said his leakage was about 10 p.ct. over the whole of the area. But he thought this was absolutely wrong. If he allowed 5 p.ct. for meter defects, it only left him with 5 p.ct. unaccounted-for spread over 100 miles; and it did not work out to more than 8 c.ft. per hour per mile of main. With regard to the quantity of gas carried through the pipes as compared with low pressure, as Mr. Helps had said, it was a very difficult matter to ascertain when one had a system of high-pressure distribution the same as he had. It did not worry him very much, as he was only supplying at one-tenth of the pressure they could supply; and until he began to supply at 50 or 60 lbs. pressure, he should not trouble about that point. The distance they were supplying was something like 25 miles; and he did not think anybody in his senses would attempt to lay low-pressure pipes that distance, especially for the quantity of gas they were out to get. One or two speakers had referred to the capital charges. He had made it quite clear that when they were entertaining this scheme, they were not looking exactly to what they were going to get immediately, but what they might get in the future. This area along the River Thames must develop. The high-pressure mains were finished in July, 1914; and the war broke out on Aug. 4 of that year. It was a matter for congratulation that they got the whole scheme through by the time he stated. But it could be seen how very largely the war had upset all his ideas with regard to the scheme. As to the question whether his Directors would have carried out the scheme under the price conditions of to-day, he did not think they would have done in 1912 and 1913 what they did if they had had any idea that there was to be a war of the magnitude and duration of the one they had had. He had refrained from giving costs. They looked forward to having a big demand in the future. There was a demand for gas; and he thought that it might interest the members to know that at any rate high pressures could be used with satisfaction. He thought the testimony he had given was conclusive of that; but there was the question of cost. Mr. Auchterlonie referred to that. He said the cost of the governors was expensive. He pointed this out in his paper; but in cases where they could get thirty consumers off one housepipe, that meant only one governor. For the consumers, they reduced the pressure to 3 in.; and the consumers got a constant pressure night and day, which was the correct thing. In their district about 65 p.ct. of the householders asked for a supply of gas. Then what happened was they sent a canvasser, and the percentage went up to 80 or 90 p.ct., and in some instances they had got 100 p.ct. of the householders. As to welding on branches under pressure, there was no real difficulty; but there was a danger. It was strange that some of them were so careful about these matters. They did not like taking risk. There was, however, risk in connecting any main—high or low pressure; but there was greater risk where high pressure was being used. Having valves every 1000 yards on the main enabled them to work on a section without the consumers on the other sections knowing anything about it. Regarding the receiver at the works, it was 1200 c.ft. capacity at low pressure. If they had a steam-joint below, they could shut the compressors down for three-quarters of an hour, and get a repair done on the engine with the receiver keeping the consumers supplied. The engines regulated their own speed, and kept at 25 lbs. pressure night and day, by the ⅜-in. pipe coming back to the steam-valve. They had found it was not necessary to have a man looking after the engine. At night they had two compressors running; and it was hardly likely both would go wrong at the same time. As to the cost of compression, their usual experience formerly was that it cost them ¼d. per 1000 c.ft.; now it was 1·34d. or 1½d. This was only an estimated amount, because they had only one set of boilers for the whole of the works; and they had to estimate so much for compression, so much for water-gas making, pumps, and so on. In 1907 when they went to Parliament for these extensions, they got 6d. allowed extra per 1000 c.ft. of gas in the area. As to the housing of the compressors, they had no increased costs, because they already had the accommodation. But the housing before the war would probably have cost £100, and now £450. The compressors, so far as he remembered, cost £1500; but they were much larger than was required at the time. The low-pressure system referred to was carried out by the Company's own men in 1907; but low-pressure pipes would cost too much at the present day. As to the purchase of the small works, they were so much dead-capital; and the only way to deal with this was to write it off year by year. As to the reduction in the quality of the gas, he was not using Nuneaton gas; but they satisfied their consumers. No syphons were necessary. By having a receiver on the works, at the periodical emptyings, they got a proportion of oil and water. They let this settle, and ran off the water; and the oil was passed into store, and used for carburetting gas as required. In their area, they had no difficulty from the soil attacking the pipes; and as to subsidence, steel mains would be just the thing for the job. Where they had to go under railway lines, they used welded steel pipes. By welding, they had a really sound job right through.

LIQUID PURIFICATION OF GASES.

In the "Gas Age" [New York] for Feb. 25 last, Mr. Lester M. Goldsmith described an apparatus for removing sulphur from gases by using lime or ferric oxide in suspension in water, instead of the dry purifier, which has been for so long a feature of gas-producing plant. The latter has several objectionable features, among which are large area occupied, spare purifiers required for alternation, labour for renewing the beds, and fire hazard. The water scrubber and cooler have never been developed seriously as a purifier, being only used as a secondary item.

The Atlantic Refining Company, after studying thoroughly all existing types of purifiers, decided that the dry purifier is unsuited for the treatment of large volumes of gas containing from 500 to 15,000 grains of sulphur per 100 c.ft. It was decided to build an experimental plant of such a form that it would be automatic (or nearly so) in operation, and involve a minimum outlay for space and labour. A suggested form for such a purifier was presented by Mr. H. Hodgson, of the United Gas Improvement Company. It consisted of two contact towers, one of wood and the other of steel, both with wood grids; the arrangement being such that the gas was passed in counter-current to the liquid containing the purifying oxide in suspension—the liquid being subsequently pumped to a wooden tower in which it encountered a current of air so as to bring about revivification. Experiments showed that checker-brick was superior to wood grids for surface contact, and therefore both towers were subsequently constructed of steel, filled with spiral brick checkered in symmetrical layers. Numerous experiments were conducted, and it was found that a suspension containing 3 p.ct. of the iron oxide was most satisfactory. Trials with lime showed that this is more costly than iron oxide, and the efficiency less.

The paper was liberally illustrated by drawings of the installation and diagrams of its performance.

Analysis of a sample of the iron oxide as delivered showed the presence of over 5 p.ct. of combined sulphur and about 3 p.ct. of free sulphur. A sample of the exhausted oxide showed as follows in percentage of the total residue:

	Primary Tower.	Secondary Tower.
Free sulphur	88·90	39·30
Combined sulphur	0·52	1·74
Ferric oxide	6·79	30·76

The general conclusions from the experiments are:

1. In given apparatus under the same conditions, there will remain a constant percentage of sulphur in the purified gas, whether the crude gas contained 10,000 grains or 1000 grains per cubic foot; and it is believed that this same relation will hold good with gases of lower sulphur content.

2. In any liquid purification plant built with two similar towers, passing the gas through in series, it can be expected that the first tower will remove 93 p.ct. of the sulphur when the total purification is 95 p.ct.—showing that the greater difficulty is encountered in removing the last traces of sulphur.

3. If the purifying liquid is maintained at a temperature between 90° and 100° Fahr., the candle-power loss will be kept down to a negligible quantity.

National Profit Sharing.—Before the Industrial League and Council, at Caxton Hall, on the 21st ult., Mr. Herbert W. Jordan lectured on a "National Scheme of Profit Sharing." Briefly, his suggestion is to have a standard scheme under which any profit beyond a certain percentage should be divided into three parts. Of these, the first one-third should be distributed among the shareholders as a further dividend; the second one-third should be distributed among employees in proportion to their remuneration, or in any other pre-determined proportions; and the remaining one-third should be applied to providing pensions for the employees, as set forth in the scheme. Cases are given to illustrate its working. Mr. Jordan, who has had many years' experience of company work, claims that his scheme can be rendered applicable to practically every trade in the country, and be carried out successfully. Copies of the lecture may be had from the Industrial League and Council, No. 82, Victoria Street, S.W. 1.

ALCOHOL OR ETHER FROM COAL.

An Industrial Process.

A recent communication to the French Academy of Sciences by M. E. de Loisy has outlined the features of an industrial process for the production of pure alcohol—or, alternatively, ether—from coal gas. The process is not new in principle; its originality lies in the application of known reactions to the particular problem.

The most important of these various reactions is that by which Berthelot effected the synthesis of alcohol by the action of ethylene gas on sulphuric acid and the decomposition by water of the ethyl-sulphuric acid [$C_2H_5O-SO_3H$] formed. As M. de Loisy says, this was a great step in synthetic chemistry; yet it was one which in the sixty years that have passed has not been applied on the industrial scale. But ethylene, although present in coal gas to the extent of only about 2 p.ct., is thus available in large quantities for industrial purposes. A ton of coal yielding 300 cb.m. of gas containing more than 4 cb.m. of ethylene corresponds theoretically with 10 litres of absolute alcohol, or (to put it another way), with a hectolitre of wine. Without taking into account the coal distilled for illuminating gas, the seven million tons of coal converted into coke for metallurgical purposes in each pre war year in France would supply 760,000 hectolitres of alcohol, on the basis of the theoretical yield. The present coke production in France being now double, the theoretical yield of alcohol from coke-ovens becomes 1,400,000 hectolitres, or 60 p.ct. of the alcohol made from agricultural products by fermentation. Although these figures require to bear a reduction in accordance with the yield on the industrial scale, they serve to show the economic importance of the problem.

M. de Loisy mentions that, in the course of a visit to England in 1918, he learnt of the attempts to solve the problem which had been made for some years by a leading metallurgical firm. The ethylene in coke-oven gases was physically absorbed by wood charcoal and recovered therefrom by the application of heat. It was found that one difficulty in the process consisted in the necessity of drying the gases, and of depriving them first of hydrogen sulphide and carbon dioxide, since these compounds were absorbed more readily by the charcoal than is ethylene. Hence treatment with lime had to be done, and as the purifying material could not be regenerated, the cost of the process was heavily increased. On this account, M. de Loisy sought to attack the problem by purely chemical methods.

The fixation of ethylene by sulphuric acid, as practised by Berthelot, takes places extremely slowly. In one test, extending over four days, 53,000 impulses were needed to combine 30 litres of ethylene with 900 gms. of acid. On the other hand, fuming sulphuric acid absorbs ethylene rapidly, forming the isomeric isothionic acid [$OHCH_2-CH_2-HSO_3$] from which, according to Berthelot, alcohol is not producible.

Now the very low vapour tension which is possessed by ordinary sulphuric acid, and which allows of a large mass of gas being bubbled through it without carrying it forward, as also the similar property of the product which is formed, well qualifies it for retaining the small quantities which the gas contains. But some means of energizing the Berthelot reaction are needed, in which object the most natural line of experiment is to employ the action of a catalyzer. The use of catalyzers in conjunction with sulphuric acid for the acceleration of the fixation of ethylene has been studied by MM. P. Lebeau and A. Damiens* in their method of analyzing mixtures of hydrocarbons. They employed for this purpose vanadic, uranic, tungstenic, and molybdenic acids in the presence of mercury. They showed that the catalytic action of these acids had a more general interest, but they did not ascertain the form in which the ethylene was fixed. M. Damiens, however, has examined this question, and has yet to publish his results; but so far as they are of industrial application they consist in the observation that as a rule ethyl-sulphuric acid is formed. But certain catalyzers exert a different action—yielding compounds which can be utilized. Lastly, certain catalyzers can be used of such low cost that their regeneration need not be considered. At the same time they raise the absorptive powers of the sulphuric acid to a degree comparable with that of caustic potash for carbon dioxide.

It should thus be possible to fix the ethylene in practice; but since, according to the theoretical reaction, twice as much acid is used as alcohol produced, a commercial process naturally requires in the first place a method of regenerating the acid at insignificant cost.

From this standpoint, it is specially advantageous to use for the absorption of ammonia in coal gas the acid from which the alcohol has been distilled—that is, the acid may be regarded as being supplied without cost for the manufacture of sulphate of ammonia. Moreover, before passing out of the cycle in this latter form, the acid can still do useful work—first in absorbing and converting traces of propylene, butylene, and hydrocarbons of the acetylene series in the gas, as it does even at 63° Baumé. It also removes water vapour from the gas; for the acid must be kept concentrated in use—it loses on dilution all its absorptive powers towards ethylene. But for the formation of alcohol it requires to be diluted; and thus by subjecting the gas to acid containing 1 p.ct. of catalyzer there are successively absorbed ethylene, hydrocarbon impurities, and water vapour—the removal of the latter being indispensable to the preceding reactions. Then, after giving up its alcohol (either alcohol or ether, according to its degree of dilution), it is converted into sulphate of ammonia.

In reducing the cost of the acid to zero, two considerable difficulties have to be overcome. The fixation of ethylene requires acid of 66° Baumé; while for sulphate manufacture, the acid need not be stronger than 50°. Thus a works wishing to obtain alcohol with the acid required for sulphate, should pay the great difference in price corresponding with the higher concentration. On the other hand, average contents of ethylene and ammonia show that at least twice as much acid is required for the former as for the latter.

These two difficulties admit of ready solution if it is considered that the gas dehydrated by the concentrated sulphuric acid can become an excellent concentrating agent for the weaker acid. The lost heat of the vapours, as in a recuperative furnace, can heat the acid to be concentrated, so that a cycle of operations can be established, into which—quite apart from the infinitesimal quantities of the catalyzer—there enters only the weaker acid regularly used for sulphate making. Thus, in order to produce alcohol from gas which is yielding also benzol and ammonia, there is actually no consumption of material, but simply the cost of making good insignificant losses. Apart from this, the alcohol (or ether) is obtained without cost other than that of maintaining absorption columns, concentrating plant, stills, and circulators. The method, M. de Loisy ends by saying, has been in use on a laboratory scale for several months in producing small quantities of pure alcohol from the gas made for the supply of Paris.

* "Comptes Rendus," Vol. CLVI. (1913), p. 557.

Prospects and Prices in America.

Addressing the members of the New England Association of Gas Engineers, in his position as President, Mr. Albert M. Barnes remarked that existing conditions in general are far from satisfactory. The large profits in nearly all lines of business, and the high wages paid to labour, have developed a period of reckless extravagance. Many expensive things are becoming necessities, instead of luxuries; and shorter hours, with lessened efficiency, tend to curtail both the production and the supply of the important essentials. The gas industry is faced with steadily increasing costs of coal, oil, and all other materials, and insistent demands on the part of labour for higher wages. It may be possible, by maintaining prompt and efficient service, and by intelligent and persistent efforts, so to extend the use of gas and to increase the sales as to offset in some measure the increased cost of manu facture and distribution. Failing this, there is no other recourse than to increase charges. Looking forward into the future, one finds little encouragement for better conditions. Present values of all commodities are very much inflated, with the demand in excess of the supply. Labour is to-day seeking a larger share in the results of industry, and is likely to get it. No one questions the right of labour to organize for the protection of the individual worker, and to secure just and proper compensation for the service rendered; but there should be provided some tribunal by means of which all differences of opinion or grievances may be investigated without resorting to strikes or lockouts, and especially in the case of public service corporations. These industries are under Government control and regulation; and in the same way the employees should be so regulated and controlled that they cannot interrupt the service to the detriment of the community.

Preparation of Nitrogen and Hydrogen Mixture.

In an article recently published in the "Journal of Industrial and Engineering Chemistry," Messrs. R. O. E. Davis and L. B. Olmstead, of the United States Department of Agriculture, deal with the preparation of nitrogen and hydrogen mixture by decomposition of ammonia. A supply of this gas was required free from impurities—especially carbon monoxide and oxygen. Anhydrous ammonia being easily obtained, it was decided to build an electric furnace to decompose it, and use the decomposed gases as the required mixture of nitrogen and hydrogen. The ammonia entered a heat interchanger in the lower portion of the furnace, passed upward through the catalyst (iron turnings or steel wool) between the heaters, then down through the catalyst, and out through the heat interchanger coils—emerging as a mixture of $3H_2$, N_2, and NH_3; the percentage of NH_3 depending on the temperature and rate of flow. The gases were passed through a water scrubbing tower, to remove the remaining ammonia, and then through a meter to the gasholder. The ammonia remaining in the scrubbed gases rarely exceeded 0·2 p.ct., and was often *nil*. For ordinary operations, a temperature of 675° C. is maintained. The average time of contact in the catalyst space (about ¼ c.ft.) has been 5 seconds; but this period could probably be reduced considerably. Employing copper chips and turnings for catalyst, it was found that a temperature of about 200° C. higher than iron was required, and a longer contact. But the figures quoted in the article are not strictly comparable, because the iron surface was probably of the order of ten times that of the copper. Because of the lower operating temperature and cheapness, iron was chosen in preference to copper. The furnace with steel shavings was in operation for about six months when the outer coil burned out. On taking apart, shavings were found to have sintered into a compact mass, and to be attached firmly to the sides of the iron pipe.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Verticals and Durham Coal.

Sir,—I notice that in your issue of the current week two statements appear to the effect that Durham coal can be better carbonized in horizontal than in vertical retorts. The first statement occurs in the Presidential Address to the Eastern Counties Association, where the opinion is given that, when unscreened Durham coal has to be carbonized, horizontal retorts with stoking machinery seem likely to hold the field; and the second is found under "Parliamentary Intelligence," where, in evidence given in connection with the Redcar Gas Bill, it is stated that when using Durham coal it paid to put in horizontal retorts instead of vertical.

In justice to vertical retorts, I write to say that I have been successfully carbonizing unscreened Durham coals in "Intermittent" verticals at the smaller of my Company's two works for the past ten years, during which period about 200,000 tons have been thus treated, and with most satisfactory results. With gentle steaming, there is an increased make of gas per ton of at least 15 p.ct. over that made in a modern installation of horizontal retorts fully equipped with coal and coke handling plants. Further, there is a reduction in carbonizing wages "coal in to coke out" of over 60 p.ct. in favour of our verticals.

In addition, credit must be given to verticals for increased production of tar and ammonia, a markedly low sulphur content in the gas, and, in our case, complete absence of naphthalene deposits either in the works or in the mains and services in the district supplied with "vertical" gas.

The solution of the alleged difficulty in connection with Durham coals is "temperature." Given sufficiently good "heats," I find no difficulty in carbonizing unscreened Durham coals in "intermittent" verticals.

Chas. Dru Drury.

Hendon Gas-Works, Sunderland,
May 1, 1920.

Sir,—In your account of the proceedings before the Unopposed Bills Committee on the Redcar Gas Bill, you report me as having said "that when using Durham coal it paid to put in horizontal retorts instead of vertical." What I actually said was "that when using Durham coal it *might* pay to put in horizontal retorts rather than vertical."

This was in answer to a question by a member of the Committee, which implied that horizontal retorts were quite obsolete; and I was anxious to correct this impression.

Arthur Valon.

5, *Victoria Street, S.W., May 1, 1920.*

"Engineer" and Mr. Helps's Demonstrations.

Sir,—I am pleased to notice, from your issue of 20th inst., that "Engineer" can go so far as he does. I am honoured by his criticism, and should like to know him.

In my letter, I thought I had made it fairly clear that I would answer any single, &c., question on conditions which, so far as I know, have not been accepted. Further, I asked for the particulars of the make of 60,000 c.ft. of 400 B.Th.U. gas with 3 p.ct. inerts, which it was stated in your editorial columns had been made from 1 ton of good coal, and which "Engineer" embodies in his tables of certain comparisons.

As this statement has not been taken any notice of, I would venture to remark that such a make has not in fact been made, and that the ton of coal referred to is one that was put into the generator; and the 8·2oths of a ton or so that was put into the boiler-flue to provide steam, has accidentally dropped out of the calculation. Of course, 60,000 c.ft. from $1\frac{8}{20}$ tons of coal is just a trifle different to a claim of 60,000 c.ft. from 1 ton—is it not? The B.Th.U. from a ton then become 17,000,000, the claim of 24,000,000 being just over 40 p.ct. too much—this is a little exaggeration. 17,000,000 B.Th.U. will take more than a little doing. I also question the quality of 400 and the inerts. Apart from the B.Th.U., there is the cost of obtaining them. It will do the industry great service if this error be corrected. How can a system which blows the good carbon into the heavens compare with a system that retains the carbon as a combustible gas?

My figure of 22,500,000 B.Th.U. from 1 ton of good coal in closed vessels is less than the actual fact, which can be demonstrated any day, and I do not put coal or coke into a boiler-flue to raise steam. Water-gas making is not fairly described as complete gasification.

In regard to the three questions that "Engineer" puts to me, I do dispute his net coal comparison; and his questions (2) and (3) are like his tables—too involved to serve any useful purpose whatever.

"Engineer" forgets, I think, that I base my comparison of costs, &c., on:

A ton of coal containing 30,000,000 B.Th.U.
A quantity of gas containing 30,000,000 B.Th.U.

I really cannot worry about therms, and follow the coke that leaves a gas-works just to see what it is used for, even if so doing would allow me to answer abstruse problems that lead nowhere.

"Engineer" seems to be most concerned about distribution. I would suggest to him that the cost of distribution depends mainly on the average distance that the gas distributed has to be carried; and on the relationship between the peak hourly-load and the average hourly-load. Let him ponder on this for awhile, together with the remarks I made as to dealing with distribution, and the diagrams I showed at my demonstrations.

Another principle or two will be found in the following statements:

"Engineer" is a gas producer.
He buys a ton of coal.
He puts (say) 10 p.ct. or so of the carbon of this coal into his mains as gas.
He could put into his mains 80 p.ct. or so of the carbon contents of the coal.
He calculates his costs of gas on the obviously bad system, whereby 10 p.ct. of the carbon is gasified, instead of 80 p.ct.
He then sells (say) one fifth of the gas or heat energy that he could otherwise sell, because of his high price.
He arrives at his costs of mains and distribution by dividing the upkeep of his mains, &c., by the heat energy sold.

How can a comparison of such divergent cases be made? If "Engineer" writes under the conditions I refer to, his theoretical difficulties will melt away.

It would be well if "Engineer," and with him the whole industry, realized that gas-works are supposed to be selling coal in gaseous form at something near the price of coal. Also, that a complicated process of dissipating heat energy through chimneys and blow-holes, and in the production of coke, tar, and liquor and some gas (sold at five times the cost of coal, B.Th.U. for B.Th.U.) cannot be called gas-making.

Geo. Helps.

Nuneaton, April 30, 1920.

Mr. Helps's Propositions.

Sir,—I am very much indebted to Mr. Hy. E. Jones for his testimony as to inerts, contained in his letter to you in your last issue, and to you, Sir, for publishing it. With such support, there should be no difficulty in blocking any Bill in Parliament which seeks to impose restrictions at the gas consumers' expense.

In regard to the big "but." If Mr. Jones will allow me, I will demonstrate to him how gas of low heating value may be distributed in existing mains without extra cost. Will Mr. Jones permit me to fix-up any section of his main system, anywhere he likes, for such lower-grade gas? A half-mile or less of an isolated main, or a main that can be isolated, complete with whatever appliances may be in use, would suit admirably for the experiment. I will undertake the necessary supervision, free of all cost. The plant needed for such a section would only cost a trifle.

Geo. Helps.

Nuneaton, April 30, 1920.

Gas Supplies and the Housing Scheme.

Sir,—The letter of your correspondent, "Distribution Superintendent," in the "Journal" of April 27 exemplifies the folly of rushing into print without making due inquiry into the matter discussed.

Since your correspondent pays me the somewhat doubtful compliment of quoting, without the context, some remarks which I made at the recent meeting of the Midland Gas Managers' Association, and has not signed his letter, may I through your columns point out to him that the scheme which I said "looked like costing about £50 per house" provides for a combined gas range (cooker, gas-fire, and hot-water circulator), gas-heated washing copper, four 10-in. gas-fires built-in, one two-light and three one-light pendants, and seven brackets including all burners and glassware, and the price which I quoted includes the provision and fixing of all apparatus, and is not a carcassing cost only? The cost of the range, boiler, and gas-fires added to the carcassing cost quoted by your correspondent, gives a prime cost of about £52 on his own figures; so that I entirely fail to find any jutification for his remark that in quoting my figure he is "turning to the other extreme." As a matter of fact, my quotation for this installation was £53 5s. per house, *plus* the cost of the services.

It is an elementary fact which should have been known to "Distribution Superintendent," that the cost of carcassing will vary very considerably according to the design of the house. In this particular case, the houses are excellently planned, and are very compact; and the actual cost of the bare carcassing—starting with a clear 1 in. run of 32 ft. to the range—worked out at £8 14s. 3d. for the seventeen points; the cost of carcassing, providing and fitting pendants, brackets, and burners being £16 for the seventeen points, or rather less than the £1 per point mentioned by Mr. Oughton. Really it is time we "ceased romancing and faced facts as they really are." But I would suggest to "Distribution Superintendent" that he should first ascertain what the facts really are, before romancing in the "Journal."

Incidentally, I notice that while the "B.C.G.A." and most progressive gas undertakings are endeavouring to eliminate the use of any piping of less than $\frac{3}{4}$-in. bore for carcassing, this very enthusiastic "Distribution Superintendent" includes 37 ft. of $\frac{1}{2}$-in. piping in his carcassing specification.

Charles H. Carder, Engineer and General Manager,
Oldbury U.D.C. Gas Department.

Oldbury, April 28, 1920.

Sir,—As to the letter on "Housing Schemes and Gas Supplies," signed by "Distribution Superintendent," the figures given as being approximate were based upon actual costs in my own recent experience.

I did not say electric wiring costs were 25s. per point (exclusive of fittings) but "exclusive of two-light fitting."

I could explain the difference in his costs and those I gave. I wonder if he has ever heard of Mallaby-Deeley and his suits?

Let this suffice, when dealing with one who is afraid to append his own name.

Ernest L. Oughton.

Milnsbridge, April 28, 1920.

Gas Extension Scheme at Accrington.—The application of the Accrington Gas and Water Board for leave to borrow £133,000 for an extension of the gas plant was heard last Tuesday by Mr. H. Byrne. It was stated that the general scheme was to develop the gas-works at Great Harwood, so as to give a more satisfactory and economical service. There are 11,913 slot-meters in use, and 9524 ordinary meters. The area of supply is 22 square miles, with a main mileage of 94. The population of the area is about 90,000; and the present indebtedness of the undertaking is £282,000. Mr. A. J. Harrison (the General Manager) stated that, with a more satisfactory supply, the gas consumption would increase very much per head. He remarked that the method of gas making at the Accrington works was "prehistoric;" and the plant obsolete. There was no opposition to the scheme.

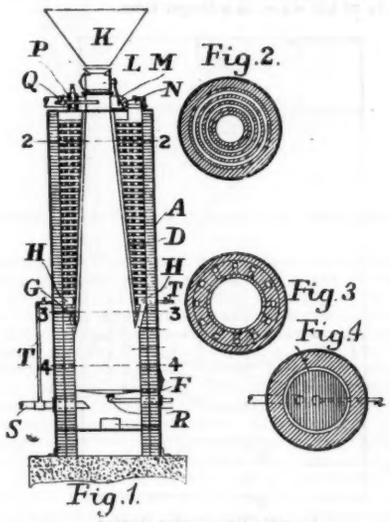
REGISTER OF PATENTS.

Manufacture of Mixed Coal and Water Gases.
No. 122,179.

BROADHEAD, C. F., of Clayfield, near Brisbane, Queensland.

No. 55; Jan. 2, 1919. Convention date, Jan. 7, 1918.

This invention relates to the manufacture of mixed coal and water gases, according to which air is first blown into the combustion chamber of a generator plant above which is a vertical retort surrounded by a chamber containing checker-brickwork; the resultant gases being passed through the chamber surrounding the retort to heat it; and then (when the generator portion of the plant is sufficiently heated) the air is shut off and steam is passed through the incandescent fuel in the combustion chamber—the resultant gases being caused to pass through the coal contained in the retort to the outlet valve. The coal is fed into the retort between each subsequent steam run, and on descending the retort is subjected to a low-temperature carbonization by the heat from the water gas, together with the heat transferred during the air-blow to the chamber surrounding the retort.



Broadhead's Mixed Coal and Water Gas Generator.

Fig. 1 is a sectional elevation of the retort and generator; while figs. 2, 3, and 4 are transverse sections on the respective lines 2, 3, and 4.

Within the shell A, lined with fire-bricks, is placed (over the generator E) a vertical retort D tapering towards the top. Fire-bars F are provided at the bottom of the generator, and ports G lead from it to the annular space H, between the retort and the fire-bricks within the shell—such annular space being filled with checkered brickwork. Coal is fed from the hopper K through a gas-tight coal-valve below; and coke breeze is fed through the door M. Waste gases from H escape through the shift-valve N; and the "commercial gas" as manufactured passes off through the valve P. Gas generated in the retort during the air-blow passes-off through the bye-pass Q.

Steam is supplied beneath the fire-bars through the jet or spray R; and air is supplied through the pipe S. Supplementary air-pipes T lead to the lower part of the space H (immediately above the outlet of the ports G) in order to supply oxygen to utilize any combustible gas which might pass through the ports G.

Inspection and ash-removal doors are provided above and below the fire-bars, and poke-holes where most convenient.

In starting the process, the generator would be filled with hot coke (which would be blown to incandescence by the admission of air through the pipes S) and coal added until brought up to the desired level. When the generator is blown up to the required temperature, the air is shut-off and steam is turned on. Coal is fed in, to the desired level, between each subsequent steam run.

It is claimed that, by means of the invention, all the gas in the coal is driven off, collected, or used as the case may be, and only ash is left behind—the tar being collected in the ordinary way.

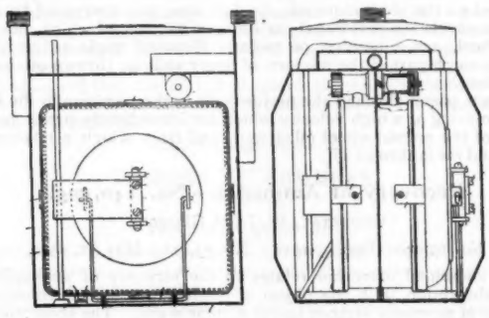
Dry Gas-Meters.—No. 139,891.

SHAKESHAFT, C. E. M., of Witton, and CLARKSON, T. J. R., of Aston, Birmingham.

No. 6119; March 12, 1919.

This invention refers to dry gas-meters furnished with two removable bellows boxes arranged back to back against a central partition of the casing; each of the bellows boxes being closed by an inflatable leather front part fixed gas-tight round the rim of the bellows box and connected to the outer ends of the lever arms of the upright oscillating shafts which actuate the sliding gas controlling valves and the recording mechanism—the bellows boxes and their inflatable leather front parts being sometimes made circular and sometimes of substantially rectangular shape with rounded corners. The object aimed at is to facilitate the removal of the bellows and their leather parts from the meter for repairs without unsoldering, and to refix the bellows or the leather parts of same in the meter without soldering.

The invention is illustrated in front and side sectional elevation. As shown, each of these box-like bellows has fixed to one side of it (preferably the top side) a tubular gas-fitting which works telescopically over a short gas-inlet pipe fixed to, and standing out from, the face of the central partition of the meter. This is between the two bellows; and the inlet pipe is connected in the usual way through ports and a slide-valve to a gas-way leading from a gas-inlet fitting on the exterior.



Shakeshaft and Clarkson's Dry Gas-Meter.

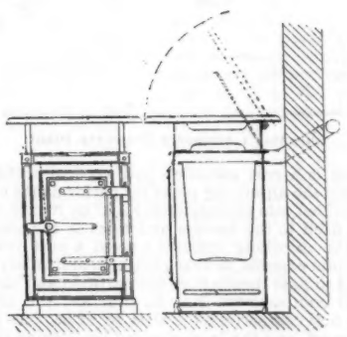
On the outer end of the inlet pipe is a cap or nut which, when screwed-up, secures the sleeve and the bellows-box to the central partition, and makes a gas-tight joint (suitable jointing washers being introduced where necessary). At the side of the bellows opposite to the gas-inlet sleeve a bracket or connection is secured, by which that side of the bellows is attached to the central partition of the casing.

Gas-Cookers.—No. 140,264.

CAMP, R. M., LING, S., and WOODHOUSE, T., of Belper.

No. 12,310; May 16, 1919.

The object of this invention is to construct a gas-cooker so that a portable and removable copper may be used in conjunction with it, thus economizing space and rendering it especially applicable to housing schemes.



Camp, Ling, and Woodhouse's Gas-Cooker.

The illustration shows a front elevation of the stove and a sectional elevation with the removable copper in position. The cooker consists of an oven with a closed top and a grill with boiling rings arranged a little distance above. The top grill is hinged, so that it can be thrown back to the wall, and leave the top of the oven free of access. This is also hinged, so that it may be thrown back; and, a short distance below, it is provided with a separate bearing or seating for the copper, which is preferably circular, and provided with an annular projection or lip round the top to fit on the seating. Thus a space is left between the top of the copper and the top of the oven, from which an exhaust flue leads steam and fumes to any suitable outlet.

The shelves in the oven are removed to permit of the insertion of the copper, which is heated by gas-jets below. When not required, the copper is lifted out, the hinged lid and top grill lowered into position, and the crown plate (usually a square enamelled plate) replaced on the stove top.

Gas Cleaning Device.—No. 140,170.

KEITH, J., and BAIN, D. B., of Farringdon Avenue, E.C.

No. 3405; Feb. 12, 1919.

This device is applicable for cleaning producer gas and freeing it from tar and other solid matters; but it is also adapted to effect the removal of dust, &c., from blast-furnace gases, flue gases, and the like.

The apparatus comprises a casing fitted with at least one revoluble paddle wheel, on which a water jet or jets can play whereby there is created within the casing an atmosphere charged with fine spray or mist, with which the gas is thrashed-up so as to thoroughly mix up particles of tar or other impurities with the water, with a centrifugal fan runner from which the tar and water are thrown off by centrifugal force, and with means for the withdrawal of the mixture of water, tar, &c.

In a practical construction the casing is partly of approximately cylindrical form and partly of truncated conical form, fitted with an axially disposed shaft on which are mounted the fan wheels—the end of the shaft projecting from the cylindrical portion desirably carrying a

driving pulley. Near the end of the cylindrical portion the casing is provided with a circumferential inlet for the gas to be cleaned.

Within the cylindrical portion of the casing adjacent to the inlet (so that it may act on the gas immediately it enters the casing) is a fan or paddle wheel having radial blades inclined to the plane of rotation. Provision is made for causing one or more jets of water to play on the wheel, whereby the water is brought to a condition of fine spray and thoroughly admixed with the gas. A second fan wheel or paddle is mounted on the shaft alongside the first one, and interposed between the two wheels is a perforated partition, on the face of which, next the first wheel, are a number of radially disposed angle strips which serve to catch part of the mixture of water and tar thrown off by the first wheel.

The gas passes through the perforations in the partition in the form of jets moving at a high velocity which are immediately struck by the blades of the second wheel (also wet), and from which a mixture of water and tar is thrown off.

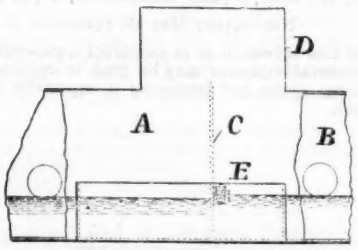
Recovery of Ammonia.—No. 140,505.

Chrystal, W. J., of Glasgow.

No. 19,940; Dec. 3, 1918. No. 13,816; May 31, 1919.

This combined invention relates to the recovery of ammonia by direct absorption, with the object of producing a neutral solution of sulphate of ammonia without loss of ammonia gas. The absorption of the ammonia gas is effected in two stages. In the first stage, the sulphate liquor is allowed to become entirely neutral, and in the second stage the liquor is kept at constant acidity—provision being made for replenishing the supply of liquor for the first stage by leading thereto liquor from the second stage when the liquor in the first stage is entirely neutral.

In the apparatus employed for the purpose the liquors in the two stages are isolated from one another—the gas passing from the first to the second stage. The degree of acidity of the liquor in the second stage—say, 2 to 3 p.ct.—is maintained by the addition of acid in suitable quantity; provision being made for constant testing of the acidity of the liquor.



Chrystal's Ammonia Recovery Plant.

The engraving is a part elevation part vertical section illustrating diagrammatically the absorbing plant for performance of the process. The vessel is divided into compartments A B by means of an upstanding partition C fixed to the bottom and sides of the absorbing vessel. On the top of the absorbing vessel is erected a cast-iron box D, into which the partition extends, so that gas which first enters compartment A is constrained to pass thence over the partition and through the box into the second compartment B. In practice, the sulphate liquor obtained in the first compartment is allowed to become neutral; then a quantity is run off, and the level restored by opening the cock E and running in acid liquor from the second compartment, where the liquor is kept at constant acidity. When the liquor in the first compartment is ready for running off, the ammonia is all absorbed in the second compartment.

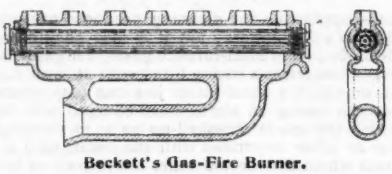
The patentee remarks: An essential step of my process consists in maintaining the liquor in the second stage at constant acidity. In this respect my invention is differentiated from other previous proposals involving the use of two saturators in series; the liquor in the first saturator being allowed to reach the desired degree of saturation, then run off, and replaced by liquor from the second saturator, whatever degree of saturation the liquor in the second saturator may have reached.

Atmospheric Gas-Fire Burners.—No. 140,576.

Beckett, W. H., of Carshalton, Surrey.

No. 5462; March 5, 1919.

This invention relates to atmospheric burners for gas-fires in which (as shown) two parallel tubes are employed—the gas and air enter one tube and pass to the end to enter the other tube, to be burnt at the nozzles positioned along the top of the second tube. In such construction wire gauze is usually positioned, either at the nozzles or



Beckett's Gas-Fire Burner.

within the nozzle tube, to prevent back-firing and ensure a better mixture of the gas and air before reaching the burning point. But the present patentee claims to obtain a better mixture of the gas and air, prevent all possibility of unevenness of flames at the burners, and ensure low maintenance by reason of the large smooth surface, by a particular construction of grid collecting over a large surface all foreign matter conveyed by the mixture before reaching the burners.

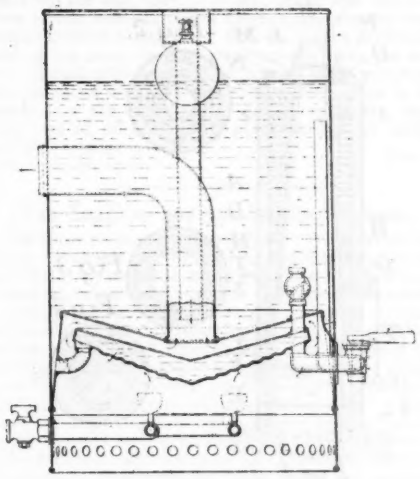
The burner is constructed from two tubes as usual, and the burner-tube provided with nozzles from three chambers—one a narrow chamber having the nozzles, the centre one forming the largest chamber, and the third (preferably smaller than the centre chamber) which connects with the gas and air supply. The outer chambers communicate with the centre chamber by slots formed along nearly the whole length, the slots being of smaller width than the diameter of the two outer chambers. Inside the larger chamber is a bundle of round metal rods, arranged in parallel order somewhat close together and held in holed plates, or a tubular cage of smooth metal rods filled with smooth surfaced balls or the like. These rods nearly fit the chamber, and are capable of being positioned therein by forming a hole in one or both ends of the chamber, and, after insertion, closing the holes by screw plugs.

Water-Heaters.—No. 140,676.

Ewart, J. W., of Mill Hill, N.W.

No. 16,328; June 28, 1919.

This invention relates to water-heaters used for supplying alternately either a small quantity of boiling water in a short time or a larger quantity of hot water in a longer time.



Ewart's Gas Water Heater.

The apparatus (as shown) comprises a casing the upper part of which is divided as a water container by a partition of inverted conical shape—with the apex directed downwards. Beneath the partition, a correspondingly shaped boiler (the shell of which is of less diameter or width than the interior of the casing) of V-shape in vertical section; the space between communicating at its centre with a central vertical flue. The gases of combustion from the gas-burners below the boiler therefore impinge on the outside of the boiler, pass up the inclined outer surface, and tend to cling to it and give up a greater quantity of their heat, before entering the downwardly directed passage between the partitions and the boiler. The inclination of the passage again causes the gases to cling to the heating surfaces before finally escaping through the central flue. To increase the "clinging tendency" of the gases to the surfaces of the boiler and partition the surfaces are provided with protuberances, in the form of studs, which check the flow.

The water container is formed with a downward annular extension below the partition, and the cold supply water is fed into this extension and thence supplied by a pipe to the bottom of the boiler. The hot water from the boiler rises through a pipe extending partly up through the water in the container and terminating in a back-pressure valve. From the bottom of the boiler a branch pipe extends to one passage of a two-way valve, the other passage of which is in communication with a pipe within the container which extends upwards nearly to the water level. By this means by turning the plug of the valve either a small quantity of boiling water may be obtained quickly directly from the boiler or a larger quantity of hot water more slowly from the container, as may be required.

Measuring the Flow of Gas.—No. 140,887.

Brayshaw Furnaces and Tools, Ltd., and Frith, J., of Manchester.

No. 5529; March 6, 1919.

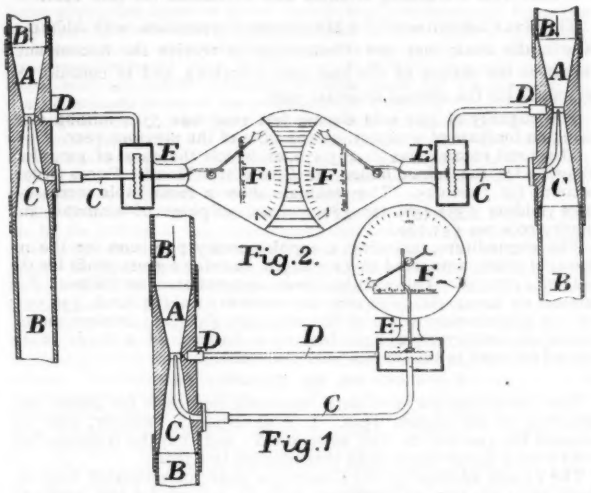
The object of this invention is to measure the flow of gas or air through pipes, and to indicate in one combined instrument the proper relative quantities to be mixed to give complete combustion.

Fig. 1 is a diagrammatic sectional elevation of apparatus designed for the measurement of the flow of gas or air.

Fig. 2 is a similar view of duplicate apparatus for the measurement of the flow of both gas and air, calibrated to show the relative proportions of each requisite to ensure the complete combustion of the gas.

The junction pipe A for connecting the instrument with the main supply pipe B for gas or air is gradually contracted to the centre so as to increase the velocity of flow through it; and two tubes C and D are inserted therein with their orifices opening at or near the centre of the junction pipe, where the velocity of the gas or air is greatest. The tube C is curved at right angles, or otherwise so placed in the junction pipe A that its orifice will face the current. It is connected to one

chamber (preferably the expansion chamber) of a differential pressure gauge E to indicate therein the pressure due to the velocity of flow of the fluid through the pipe B. The tube D is so placed that its orifice is at right angles to the current, and is connected to the other chamber of a different pressure gauge, to indicate therein the static pressure of the fluid within the pipe B. The resultant of these two pressures is shown on a dial F calibrated in cubic feet per hour.



Frith's (Brayshaw Furnace Company) Gas-Flow Recorder.

The pressure gauge E is formed with a sealed corrugated chamber, which will expand under pressure; and to this the velocity pressure tube C is connected. The expanding chamber is set in another chamber to which the static pressure tube D is connected—the expansion of the first chamber representing the difference between the pressures and, consequently, the velocity of flow of the gas or air. The gauge is provided with a dial and pointer, the latter rotated by a rack-and-pinion or quadrant connected by a rod to the expanding chamber and oscillated by the movement of the latter.

Where gas and air are used together—as in furnaces, stoves, or internal combustion engines, two instruments may be employed as shown in fig. 2, and mounted with their dials F alongside one another. The calibrations are on two adjacent arcs, and the calibrations on one may be connected with the calibrations on the other, and so show the correct mixture of gas and air to use for complete combustion of the gas; and thus the flow can be adjusted to bring the pointers on the two dials to the correct relative readings.

APPLICATIONS FOR PATENTS.

[Extracted from the "Official List" for April 28.]

Nos. 10,773—11,454.

BRANSOM, W. J.—"Gas-producer plant and gas-engine plant supplied therefrom." No. 11,423.
BRENTFORD GAS COMPANY.—"Gas cooking-ovens, stoves, and ranges." Nos. 10,853, 10,854.
BUCKLEY, W.—"Doors for mouthpieces of retorts." No. 11,325.
FALL, T. A.—"Valves and cocks." No. 11,220.
FALLET, P.—"Acetylene gas-generators." No. 11,158.
FOX, T.—"Securing leather, &c., diaphragms in gas-meters." No. 11,416.
HAGGIE, R. H.—"Upright incandescent gas-mantle, and means for manufacture thereof." No. 11,231.
HOWGATE, E.—"Retorts for manufacture of coal gas, &c." No. 11,000.
JACKSON, E.—"Geysers, &c." No. 10,865.
JENNINGS, G. L.—See Brentford. No. 10,854.
JOHNSTON, A. A.—See Brentford. No. 10,853.
JOY, B. C.—See Tribe. Nos. 11,236, 11,237.
LEWIS, W. I. G.—"Gas-heaters." No. 11,380.
LINDSAY LIGHT COMPANY.—"Recovery of thorium." No. 11,115.
MACDONALD, W. R.—"Apparatus for cracking oils." No. 11,100.
MARTIN ENGINEERING COMPANY.—See Jackson. No. 10,865.
MEADE, A.—"Manufacture of coal gas." No. 10,971.
NATIONAL GAS-ENGINE COMPANY.—"Means for operating valves of internal combustion engines." No. 11,324.
READ, H. J.—See Bransom. No. 11,423.
ROBINSON, S.—See Fox. No. 11,416.
ROLLASON, A.—"Manufacture of refractory materials for furnace linings." No. 11,002.
SCHELLER, F.—See Fallet. No. 11,158.
SECCOMBE, C. P.—"Gas cooking-stoves." No. 10,883.
SHAW, H. S. HELE.—See Tribe. Nos. 11,236, 11,237.
TINDALE, H.—"Distillation of coal tar, and products derived therefrom." No. 10,924.
TRIBE, E.—"Pipe-joints." Nos. 11,236, 11,237.
WADE, H.—See Lindsay. No. 11,115.
WEST'S GAS IMPROVEMENT COMPANY.—See Buckley. No. 11,325

The amount of cash taken out of the penny-in-the-slot meters provided by the Accrington District Gas Board, during the twelve months ended March 31, was £37,270. Reported in pennies, this gives a total of nearly 9,000,000 coins, and a weight of 83 tons.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

Progress of Bills.

The Public Utility Companies (Capital Issues) Bill was read a second time, and committed to a Committee of the whole House.

The Newtownards Urban District Council Bill was reported with amendments.

It was agreed that the Earl of Strafford should be a member of the Select Committee on the South Metropolitan Gas Bill in place of Lord Clifford of Chudleigh.

HOUSE OF COMMONS.

Provisional Order Bills.

Among the Provisional Orders to be confirmed by a Gas and Water Orders Confirmation Bill are those relating to Great Yarmouth Gas, and Mablethorpe and Sutton Gas.

A Gas Orders Confirmation Bill deals with Provincial Orders relating to Braintree and Bocking Gas, Great Marlow Gas, Ilford Gas, Stone Gas, Taunton Gas, and Watford Gas.

Electric Lamp Industry and Profiteering.

Mr. SWAN asked what action it was proposed to take in connection with the finding of the Sub-Committee set up under the Profiteering Act who investigated the electric lamp industry.

Sir R. HORNE (President of the Board) replied that certain representations had been received from the Electric Lamp Manufacturers' Association of Great Britain, Ltd., concerning the report of the Sub-Committee appointed by the Standing Committee on Trusts to conduct an investigation into the electric lamp industry. These representations had been referred to the Sub-Committee, in order that they might consider whether they desired to modify their report in any respect in consequence of the representations. Until he had had an opportunity of considering the reply of the Sub-Committee, he was unable to make a definite statement on the matter.

Wrexham Gas Company's Dividend.

Sir ROBERT THOMAS asked the President of the Board of Trade whether he was aware that it became necessary for the Directors of the Wrexham Gas Company (a statutory undertaking) to apply to the Board of Trade for powers to increase the maximum price of gas from 4s. to 5s. per 1000 c.ft. owing to the increased price of coal, labour, and materials; that an Order, dated Sept. 29, 1919, was granted, but at the same time restricting the dividend to 3¾ p.ct. per annum; that the Company's accounts for the year ended Dec. 31 last had been submitted to the Board of Trade for approval, and the Directors recommend the payment of 5 p.ct. per annum for the first nine months of the year—*i.e.*, to the date of the Board of Trade Order—and at the rate of 3¾ p.ct. per annum for the last three months of the year; and that a notification had now been received from the Board of Trade stipulating that the dividend for the whole of the year 1919 should be at the rate of 3¾ p.ct. per annum only, notwithstanding the fact that the Order came into force as from Sept. 29, 1919; and whether, as this action of the Board would affect the financial position of the Company, he would give the case further consideration.

Sir R. HORNE replied that the facts were as stated. The matter at issue was one which depended on the legal interpretation of the Statutory Undertakings (Temporary Increase of Charges) Act, 1918, of the Order made by the Board of Trade thereunder, and of the Company's Special Act. He would give further consideration to the case, and would inform Sir Robert of the result.

Sir R. THOMAS asked why, in the first instance, was the rate of interest restricted to 3¾ p.ct.

Sir R. HORNE said the matter was too elaborate to go into in answer to a question; but, according to the regulations that dealt with such matters as this, they had to take a particular rate of interest over the appropriate period for which the average dividend was paid. What the Company did not do was to inform the Board of the fact that they were entitled to pay half-yearly dividends. Now that the matter had been brought to his notice, he was prepared to consider it from the point of view of the half year.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—KING'S BENCH DIVISION.

(*Before Mr. Justice* SHEARMAN.)

Monday, April 19.

J. M. Steel & Co. v. Gas Light and Coke Company.

This was an action brought by Messrs. J. M. Steel & Co., chemical merchants, Queen Street Place, London, against the Gas Light and Coke Company, claiming the return of money alleged to be had and received by the defendants for, and on behalf of, the plaintiffs, and for damages for alleged breach of contract.

Mr. INSKIP, K.C., M.P., for plaintiffs, stated that the claim was in respect of purchases of naphthalene. The transactions were in April, 1916, and then a series of mistakes occurred, and the real facts only came to light in 1918. Plaintiffs purchased the naphthalene which they required for shipment as merchants. Before the war, plaintiffs had been in the habit of buying considerable quantities of the stuff

from the defendants. During the war (as in many other trades) speculators came into this trade, with the result that supplies of defendants' goods became depleted, and plaintiffs were compelled to go into the market and purchase from people who had purchased from the defendants. One of these people was a Mr. M'Carthy, who was the acting agent or an employee of a company called the Williams Drug Company, of Bombay. Plaintiffs bought from M'Carthy supplies of naphthalene which in the past they had got from defendants. On March 8, 1916, plaintiffs bought from M'Carthy 10 tons of ball naphthalene at £46 10s. per ton. On March 10 plaintiffs paid him £465, and obtained a delivery order on the Gas Company. On the same day, plaintiffs sent the delivery order to the defendants; and on the following day defendants acknowledged it. On April 12 plaintiffs asked the defendants to prepare the goods for delivery to them, as plaintiffs had engaged freight space; and they gave them the marks to be put on the goods, which were being shipped to China or Japan. Defendants marked-up the goods; but delivery was not taken on that day, because some difficulty over shipment arose, and eventually plaintiffs only took delivery on April 27. When plaintiffs' agents' van went for the goods, defendants said they could not make delivery until plaintiffs had paid for the goods. Whereupon plaintiffs by mistake paid the defendants the sum which they demanded—viz., £425. Plaintiffs, therefore, had paid M'Carthy £465, and defendants £425. Two years later, plaintiffs discovered the error, and now asked for the return of the £425, as money paid under a mistake of fact. The second transaction was on July 29, 1916, when Messrs. Steel bought 10 tons of naphthalene balls from M'Carthy at £47 per ton. As a matter of fact, said Counsel, on April 6 of the same year M'Carthy had bought some tons of the stuff from the defendants, and it was lying at the defendants' works; but plaintiffs knew nothing of this. On Aug. 4, 1916, M'Carthy paid for the goods, £450, and gave plaintiffs a delivery order on the defendants, and instructed the defendants to deliver the goods to plaintiffs. On the same day, plaintiffs made a telephonic inquiry of the defendants as to whether the goods had been paid for by M'Carthy; and they said they had. Plaintiffs thereupon paid to M'Carthy £475, their contract price for the 10 tons. At the time, plaintiffs were in difficulties owing to the amount of stuff they had awaiting shipment, and did not take delivery at once. They had since requested delivery; but defendants had failed to deliver. Plaintiffs therefore also claimed the return of the money they had paid in respect of this second transaction, for a consideration which had wholly failed, and also damages for alleged breach of contract.

Mr. Neilson, for the defendants, submitted that the plaintiffs had made out no case. Because they had marked-up some goods with certain marks in no way appropriated the goods to the plaintiffs; nor was it an assent by defendants to the sale to the plaintiffs. The claim on the first contract failed, as it did on the second one, because at no time had defendants ever recognized any ownership in the goods by the plaintiffs.

Tuesday, April 20.

His Lordship said he had come to the conclusion that plaintiffs failed on the first claim, but succeeded on the second. With regard to the first one, Messrs. Steel paid defendants apparently overlooking that they had already paid M'Carthy. It was admitted that defendants had never been paid by M'Carthy, and had only been paid once by plaintiffs. He could not hold that this was plaintiffs' money held by defendants to plaintiffs' use, or that defendants had done anything which amounted to a recognition of plaintiffs' title. Defendants had not been overpaid, and they had not got any money in their hands which according to equity ought to be repaid. On the second claim, he was satisfied that plaintiffs had forgotten all about the fact that they had paid £450. The parties had negotiated under the mutual mistake that nothing had been paid. It was clear that plaintiffs eventually paid their money in respect of their indebtedness for the whole amount of the goods in question, forgetting that £450 had been paid; while defendants made the mistake of paying it to M'Carthy. Therefore they had £450, really the money of the plaintiffs which must be repaid. There would be judgment for the plaintiffs for £450, with general costs of the action; but defendants would have the costs of the other issue on which they succeeded.

Liability for Damage to a Lamp Standard.

Last Tuesday week, a King's Bench Divisional Court, consisting of the Lord Chief Justice and Justices Avory and Roche, dealt with the case of *Stickles v. Cripps*, in which the decision of the Margate Justices was appealed against. Counsel explained that a case was stated by the Margate Justices, from which it appeared that the question for decision arose out of clause 20 of the Gas-Works Clauses Act, 1847. The Act laid it down that any person who carelessly or by accident broke or threw down or damaged any pipe, pillar, or lamp belonging to the gas undertaking should pay the cost not exceeding £5. There was no doubt that accidental damage was done to a lamp standard by a man driving a pantechnicon van. But although the man pleaded "guilty," the Magistrates dismissed the case against him because when he did the damage he was obeying the instructions of a policeman, and was driving on the wrong side of the road to allow a tramcar to pass. In doing this, his wheel got into the gully at the side of the road, with the result that the van tipped and hit the lamp-post. Mr. Justice Avory held that there was no reason why, even if he obeyed the constable, he should get his wheel in the water-gully. Counsel agreed, and said the accident was not the inevitable consequence of following the constable's instructions. The Court remitted the case to the Justices that the amount of the damage should be assessed.

Upon a letter being read to a Committee of the Newhaven Urban District Council from the local Gas Company, intimating an increase of 1s. per 1000 c.ft. in the price of gas, the Committee agreed to recommend that the London, Brighton, and South Coast Railway Company should be asked if they were in a position to supply electric lighting for public lamps in the town. The Council adopted the recommendation.

MISCELLANEOUS NEWS.

MANCHESTER GAS UNDERTAKING.

Last Year's Working Results and Estimates for this Year.

The Gas Committee of the Manchester Corporation, with Alderman Kay in the chair, met last Wednesday to receive the Accountant's report on the results of the past year's working, and to consider the estimates for the current financial year.

The quantity of gas sold during last year was 5584 million c.ft., being an increase of 3·16 p.ct. on the sales of the previous year.

The total income was £1,433,476, of which the sales of gas, after allowing for the rebate under the Coal (Pit's Mouth) Prices Order, account for £986,025. The residuals show a remarkable increase—coke yielding £333,458, tar £80,233, and sulphate of ammonia and sundry receipts £33,760.

The expenditure, including a supplementary provision for the renewal of plant, amounted to £1,262,518, showing a gross profit for the year of £170,958. This sum has been appropriated as follows: For interest on loans, &c., £38,106; for statutory sinking fund, £59,538; for the contribution in aid of the city rate, £31,525; to meet certain capital expenditure, £23,042; leaving a balance of £18,747 to be carried forward to the current year's account.

Estimates for the Current Year.

The Committee are faced with unprecedented costs for labour and materials in the present year. It is anticipated, however, that the demand for gas will be well maintained; and that the residuals will yield even a higher figure than that reached last year.

The figures adopted by the Committee show an estimated total income of £1,584,000, as compared with £1,433,476 for last year—an increase of £150,524. This increase is attributable to the higher price ruling for gas for the first half of the year, compared with that of the corresponding half of last year, and to the higher yield from coke and tar.

The expenditure for the year is put at £1,541,416, to which has been added the following commitments:

Interest on loans	£43,000
Statutory sinking funds	59,732
Contributed in aid of rates	32,473
Capital expenditure to be met out of revenue	34,000

Giving a grand total of £1,710,621, or £126,621 in excess of income. From this has to be deducted the amount brought forward from the previous year, £18,747; and the balance of the reserve fund, £22,114—leaving an estimated net deficit at March 31, 1921, with gas at present prices, of £85,760.

The capital outlay on the undertaking stands at £3,247,354; and the net outstanding loan debt, after allowing for the unapplied sinking fund, is £724,115, or 22 p.ct. only of the outlay.

The renewals fund, after meeting expenditure to the extent of £131,770 for the past year, amounts to £150,268. This fund has been of the greatest possible benefit since it was established in 1906, and especially so at the present time, when renewals deferred through the war have now to be carried out at considerably enhanced cost.

Growth of Business.

There has been considerable difficulty experienced in obtaining the necessary supplies of coal; and the delay caused by the war in the carrying out of the extension of the manufacturing plant necessary to cope with the increased demand for gas has had a prejudicial effect on the growth of the business.

Notwithstanding the abnormal conditions, satisfactory progress has been made. The sales of gas were 5584 million c.ft., which shows an increase of 3·16 p.ct. for the year; and the quantity of coal, &c., carbonized was 475,121 tons, or an increase of 18,645 tons.

There has been an increase of 113 million c.ft., or 4·14 p.ct. in the day consumption (from 8 a.m. to 6 p.m.), and 65 millions, or 2·07 p.ct., in the night time (*i.e.*, 6 p.m. to 8 a.m.). The larger increase in the daytime is due to the extended facilities and the use of gas for industrial purposes.

The number of gas-consuming devices installed also shows a satisfactory increase. The total number of cookers and grillers fixed up to March 31 last was 139,102—an increase of 5510; while the number of fires was 32,796, or an increase of 4765. About 90 p.ct. of the consumers have now been supplied by the Corporation with a cooker, griller, or fire.

The number of consumers taking gas through ordinary meters was 116,079—an increase of 934 for the year; and the revised figures show there were 76,033 consumers taking gas through automatic meters.

BELFAST CORPORATION GAS-OIL CONTRACT.

The finding has been announced of the Defence of the Realm Losses Commission in regard to a claim made by the Corporation of Belfast in circumstances which were set forth in the "Journal" for Feb. 17 [p. 376]. The Corporation's claim was for a payment out of public funds in respect of loss sustained by them owing to alleged interference by the Government by the diversion of a tank-steamer (the "Hotham Newton") which it had been arranged should deliver gas-oil to the Corporation. The sum claimed was £40,298.

In their finding, the Commissioners say it was admitted by the parties that the Government had never requisitioned the "Hotham Newton," that the steamer sailed for an English port with a cargo of refined oil, that she subsequently went ashore and never carried any oil for the Corporation, and that the Corporation had to buy the 5480 tons of oil in the open market at a greatly increased cost. Sir John Simon, as

Counsel for the applicants, submitted that specific orders were given that the steamer was not to carry out that which the Anglo-American Company had directed it should fulfil; but, on the contrary, that it should take-up refined oil, instead of gas-oil; and, that, having regard to the constitution of the Pool Board, this was really Government action, as the Pool Board were acting on behalf of the Government. In considering this argument, it is necessary to remember that at the time the diversion of the "Hotham Newton" took place the only regulation giving the power to divert vessels was that conferred upon the Shipping Controller alone by the Defence of the Realm Regulations made on June 28, 1917, and that it was not until Nov. 16, 1917, that power was conferred upon the Shipping Controller to make arrangements with any other Government Department for the exercise by that department of any of the powers of the Shipping Controller under this regulation. No evidence was given that the Shipping Controller had made any order for the diversion of this vessel; and no other person had any authority on behalf of the Government to make any such order. It was therefore impossible for the Commission to draw the inference that such an order was given.

The Commission also find, as a fact, that it was at the request, and not by the orders, of the Government that the Pool Board stopped all further supplies of gas oil to the Corporation, unless they obtained the licence of the Explosives Supply Department. The Commission are of opinion that the Pool Board was a voluntary association of companies and persons dealing with their own supplies and carriage of petroleum products, and that the only powers which the Board possessed and exercised were those conferred by the agreement constituting the Board, of regulating and dealing with the vessels belonging to the participating companies. In other words, the associated parties submitted their business to the control of a representative Board, whose jurisdiction did not extend to the business of anyone who did not choose to adhere to the agreement. In pursuance of the agreement, the participating companies put into the pool certain vessels, and surrendered to the persons managing the pool all the powers vested in them as charterers or owners of such vessels dealing with them. Therefore it was not necessary that any compulsory powers should be sought from the Government in order to divert the "Hotham Newton;" and in the absence of any evidence to the contrary, the Commission have come to the conclusion that there was no interference by the Crown acting in its prerogative or under any of the Defence of the Realm Regulations in regard to the diversion of the steamer.

The Commission recommend payment to the applicants out of public funds of the sum of £42 towards the necessary expenses of preparing the application.

"B.C.G.A." CONFERENCE AT DARLINGTON.

The first of a series of Housing Conferences in different parts of the country of the British Commercial Gas Association was held on Friday, when, under the auspices of the Northern District section, there was a large gathering in the Technical Institute, Darlington. Councillor Charles F. Dixon (the Chairman of the Darlington Gas Committee) presided.

After a welcome from the Mayor, Mr. F. W. Goodenough said one of the important questions in connection with housing was obviously the provision to be made for the use of fuel in the home. All these problems were also affected by the question of whether they constructed their buildings as cheaply as possible. If they adopted the wrong methods of using fuel in their homes, they were obviously going to affect unfavourably the labour problem, the transport problem, and the fuel problem of the future; and also they brought in the question of their chemical resources. If out of 3 tons of coal mined, 2 tons could be exported at the present high prices, this would help to pay for the war, and to restore the unfavourable balance of exchange. If, however, of the 3 tons named, all had to be used to do the work that 1 ton might have done, they would be detrimentally affecting their financial problem. There were two ways of using coal for producing heat, one of which required more to be mined than the other. They had been given to understand that electricity was going to solve all the problems of domestic and industrial fuel, as well as light. He was not there to say a word against the development of electricity. It was a very important public servant, with a very big field for development in the future; but this field was not in the direction of its use as a heating agent. He wanted to make it quite clear that, if electricity were adopted as a means of cooking and heating, it would necessitate the mining of from 3 to 4 tons of coal for every ton required to be mined if gas were used.

Mr. H. H. Creasey read a paper on "Gas Heating in Relation to Economy in Building;" and one contributed by Mr. Walker, on the the labour-saving equipment which gaseous fuel offers in housing, was read by Mr. Goodenough. Mrs. M. A. Cloudesley Brereton dwelt upon the hard lot of the housewife; and said now that women have the vote it is up to them to see that the new houses are not as stupidly erected as the old ones, and that they are built straight away for gas-fires in the parlours and bedrooms, so that at any rate there shall be no carrying of coals and hot water upstairs. American women, she added, are aghast when they see the arrangements in the houses here, because in their country the workmen's dwellings are all provided with gas fuel apparatus. "The Coke Smoke Curse and the Nation's New Homes" was dealt with by Dr. C. W. Saleeby, who remarked that it was a subject upon which he had been writing and talking for nearly twenty years.

Cordial votes of thanks were passed to those who had contributed to the proceedings.

The York municipal employees connected with the National Amalgamated Workers' Union have, through the Secretary, made an application for an increase in wages of 5s. per week. The application will be considered after data have been obtained from other towns with respect to the wages paid there.

EXAMINATIONS IN GAS-FITTING.

City and Guilds of London Question Papers.

The following are the questions which were set by Mr. Harry Kendrick, of Stretford, in the written papers, for candidates in the examinations in "Gas-Fitting," which took place on Monday of last week under the auspices of the City and Guilds of London Institute. The marks accorded are shown in parentheses.

Grade I.

[Not more than six questions to be attempted.]

1. There is a general tendency at the present time to send out gas of lower quality and different composition to that formerly supplied. What is it proposed to add to effect the reduction? How will the various mixtures proposed affect the quantity of air required for complete combustion? Which mixture will require most air, and which least, to produce the best results? (40.)

2. A house of seven rooms is to be carcassed and fitted throughout with gas. The contract includes service pipes, meter, all piping, two pendants, seven brackets, three gas-fires, one cooker, one radiator, one hot-water apparatus, and the necessary burners, mantles, and shades. Give a complete list of all tools required for carrying-out the work. Describe each one fully, and state the uses to which it is generally put. (60.)

3. Do you prefer iron, compo, or lead piping for general gas-fitting work? State your reasons for your preference. For what fitting work is each kind of piping specially adapted? What precautions would you take in each case to prevent injury or accident to piping when fixed in position? (50.)

4. How many kinds of radiators are there in use? Which do you prefer, and why? (50.)

5. Give a sketch and full detailed description of each kind of pipe-joint in general use on large and small gas-fitting work. What jointing material would you use in each case to ensure a gas-tight job, and why? (50.)

6. In what way does a wet meter differ from a dry meter? What precautions are necessary when fixing both (*a*) in a warm position, (*b*) in a damp position, (*c*) in an exposed position? (40.)

7. Sketch and describe the uses of a regulating nipple, a bunsen-tube, a mixing-chamber, and an air-regulator in a "C" incandescent gas-burner. (40.)

8. Sketch and describe the instrument usually used for indicating gas pressures. State how it is used, and show on it a pressure equal to 2½ in. of water column. (40.)

9. State step by step how you would prepare from a 15 ft. length of ¾ in. iron barrel, and the necessary fittings, a connection from a service-pipe to a dry meter where the service-pipe falls to the meter, and a connection to the house-fittings from a wet meter with the same materials, but where the house piping is of lead. Give details of all the fittings you would use. (60.)

Grade II.

[Not more than six questions to be attempted.]

1. A dwelling-house is to be fitted throughout with gas for lighting, heating, hot-water supply, and cooking. Would you run one main or not? Give your reasons. If not, in what order would you connect the various pipes at the meter to prevent condensation water getting into the meter, and so as to cause least annoyance to the tenant. If there should be an interruption in the supply, which service would be likely to cause least difficulty, and why? (60.)

2. What are the principal products from complete combustion of gas? State approximately the volume of each obtained from 100 c.ft. of ordinary town's gas. (40.)

3. A few minutes after the oven of a gas-cooker has been lighted, a strong smell of gas is noticed; and on examination the burners are found to be extinguished. What are the causes of this? What precautions or repairs are necessary to prevent a repetition. (40.)

4. When watering meters fixed on consumers' premises, it is necessary to adopt certain precautions. What are these? Describe minutely the operations necessary to ensure accuracy of watering. What working parts of a wet meter are affected by the watering (*a*) if over-watered, (*b*) if correctly watered, (*c*) if under-watered; and what effect has each on the registration of the gas passing through the meter? (50.)

5. Are there any meters constructed to allow of a large variation in the water-line, and that will register correctly within certain fixed limits? If so, sketch and describe in detail any one meter with which you may be acquainted. (40.)

6. Sketch and describe a "C" incandescent gas-burner, a bijou inverted burner, and a No. 3 inverted burner. State the normal consumption of gas for each when supplied with gas at 30-10ths pressure, and what illuminating power each would develop if supplied with gas of 450 B.Th.U. quality. (60.)

7. What would be the effect on the illuminating power obtained from the burners in Question 6 when chimneys and globes are attached to them after the gas and air have been adjusted to give the best results? State reasons for your opinions. (50.)

8. What is the "Lancet" test used for? Describe its application to gas apparatus. How would you remedy the defects in gas apparatus that it indicates? (40.)

9. A valve on a 2-in. service-pipe immediately inside a building is defective. Describe minutely how you would renew this, with the gas on, and what precautions you would take against the loss of gas and possible gassing. (40.)

Final Examination.

[Not more than six questions to be attempted.]

1. Having been sent to a house to investigate a general complaint of defective working described by the consumer as due to the poor quality of the gas, you find that generally all the burners and apparatus are giving very poor results—the burners showing half the amount of illumination, and the fire and cooker burners lighting-back; but with

only one or two points in use good results are obtained. To what causes may this trouble be attributed? How would you proceed to ascertain the exact nature of the trouble, and how would you remedy matters? State your reasons fully. (60.)

2. A complaint having been received of oscillating lights over a large area, investigation showed that it was due to defective working of a gas-engine situated some distance away. Describe your method of investigation proving the foregoing, and state how you would propose to remedy the trouble. Sketch apparatus that should be fixed to prevent further complaints, and describe its working parts. (40.)

3. Describe and sketch in detail the controller of a system of distance lighting suitable for a tool factory. A shop in this works is 120 ft. long by 30 ft. wide; and the machines are fixed in four parallel lines down its length, with the necessary walking-space between each. How many 100 c.p. lamps will be required for the efficient lighting of the whole, and how would you arrange the wiring and pushes for distance lighting of same? (60.)

4. It is intended to fix a circulator of the cast-iron type to supplement an existing hot-water supply from the kitchen boiler. Sketch and describe the arrangement of apparatus and pipes to give a rapid supply of hot water and to cut off the gas supply when the temperature of the water in the cylinder reaches 160° Fahr. (50.)

5. Exhaustive experiments have proved that the air of a gas-lighted room is just as pure as the air in a room lighted electrically. Give the reasons for this. Is the effect of human exhalations on the purity of the air of a room more or less than that of the products of combustion? Give reasons for answer. Can gas be utilized for changing the air of a room otherwise than by using gas-fires? If so, how? (50.)

6. Describe and sketch one apparatus in general use for lighting street-lamps by a pressure-wave. Sketch a street-lamp showing the position of the apparatus, together with the necessary fittings for efficient lighting and regulation of the burner and distribution of the light from the mantle. (40.)

7. What are the effects of radiant and convected heat on the air and contents of a room heated by a gas-fire? Describe and sketch in position a gas-fire that will assist ventilation of a living-room. (40.)

8. What are the advantages of a gas-furnace for fine metal melting compared with a solid fuel furnace? With gas at 4s. per 1000 c.ft. and coke at 2s. per cwt., what are the relative costs of melting brass in both types of furnace? (40.)

9. From which system of lighting is the better duty obtained—high-pressure or low-pressure gas? State your reasons, and give figures to prove your answer. (40.)

COKE AND BYE-PRODUCTS EXAMINATION.

The City and Guilds of London Institute Final Examination in Coke and Bye-Product Manufacture was held last Wednesday; the Examiner being Mr. D. V. Hollingworth. There was no Grade I. examination this year. The following were the questions put, and the marks obtainable.

Final Examination.

[Not more than eight questions to be attempted.]

1. Discuss the theoretical considerations upon which processes of coal-washing are based, and describe shortly, giving sketches, two dissimilar types of washers. (40 marks.)

2. What alterations in the design of regenerative coke-ovens would be required to enable producer gas to be used for heating, instead of coal gas? What quantity of coal (expressed as percentage of coal carbonized) would have to be gasified in producers to supply the heating gas? Show clearly your method of calculation. (45.)

3. Give the composition and name of any coking coal. Discuss the influence of the constituents on the quantity and quality of the coke, gas, and products you would expect such a coal to give on carbonization. State the method of calculating the amount of "available hydrogen" that the coal contains. (45.)

4. Describe exactly how you would determine experimentally the quantity of the steam consumed in the manufacture of sulphate of ammonia from ammoniacal liquor. State the quantity and cost of the steam per ton of sulphate made. Show how you arrive at the latter figure. (40.)

5. Give a full description of the method of ascertaining any one of the following: (*a*) Flash-point of heavy naphtha, (*b*) viscosity of a tar oil, (*c*) calorific value of coke-oven gas, (*d*) calorific value of motor benzol. Sketch the apparatus required, and state the essential data of an actual test that you have carried out. (40.)

6. Discuss fully the principal differences between American and British bye-product coking practice, making reference to differences in quality of coal, design of ovens, nature of refractory material, period of coking, and yield of products. (40).

7. Describe, with sketches of apparatus employed, two methods by which distillation of coal tar may be effected at temperatures lower than the boiling-points of some of the distillates. State the advantages and disadvantages of each system. (40.)

8. Give the complete specifications under which any three of the following products are sold: (*a*) Creosote fuel oil, (*b*) prepared tar for road treatment, (*c*) motor benzol, (*d*) pyridine, (*e*) 60's carbolic acid, (*f*) cresylic acid, (*g*) 25 p.ct. concentrated ammonia liquor, (*h*) pure naphthalene, (*i*) crude anthracene, (*j*) solvent naphtha. (35.)

9. Compare the effects on output and quality of coke, temperature of carbonizing, yield of products, operating costs, &c., of using compressed and uncompressed charges. (35.)

10. Make sketches, approximately to scale, of any well-known type of fractionating column and dephlegmator used for the separation of mixtures of benzene and its homologues. Show details of construction of the apparatus, and describe fully its working. (45.)

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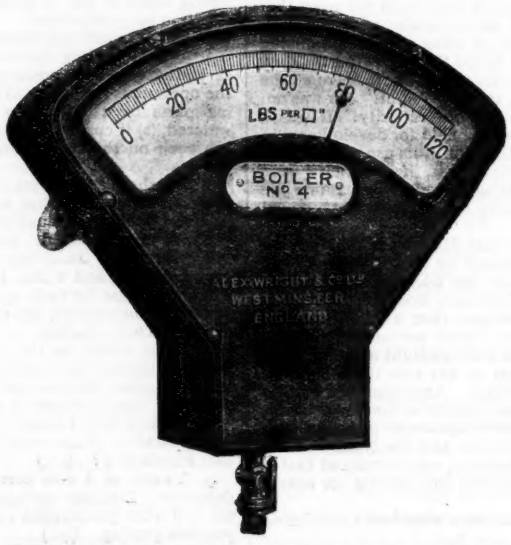

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RADIATION LTD.

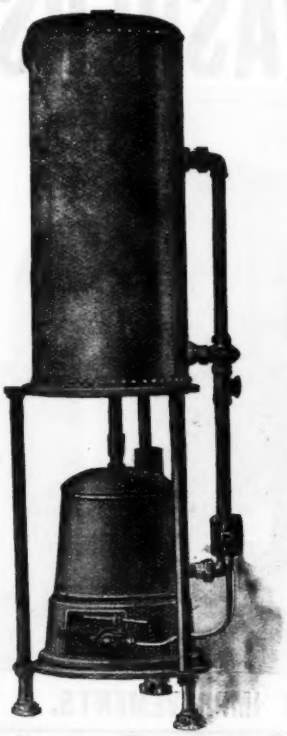
General Meeting.

The first report and balance-sheet [*ante*, p. 217] were presented to the shareholders at a meeting in the Grand Hotel, Birmingham, last Tuesday—Mr. H. JAMES YATES (the Chairman) presiding.

The CHAIRMAN, in moving their adoption, said that, as Chairman of one of the Companies now embraced in Radiation Ltd., he had at successive annual meetings impressed upon the shareholders the lines on which that Company had for years been working—the labour-saving methods and appliances; the perfected means for ensuring interchangeability of parts; and the simplified methods of production in large quantities. These methods had reached, in the Company he referred to, a very high degree of development—including the unique special feature that new improvements were in each case interchangeable with all current previous patterns. The record of that Company during the period he had been associated with it, when these methods had been in practice, had been an exceedingly progressive and successful one. During all these years, however, he had felt impressed with the conviction—which had grown stronger as the result of the unexampled industrial conditions of these later times—that if they could join hands with a number of other manufacturers making similar articles, each with success in its individual sphere, it would be quite possible to effect further reductions in the production costs of all the combining concerns to an extent unattainable in the concerns individually. Now that they had succeeded in bringing together the four firms, including their various subsidiary concerns, it was their purpose to develop the capacities and facilities of each for the gas-appliance business in this country on a scale to which not even the largest and most successful of the individual Companies could have hoped single-handed to attain. They were also laying themselves out to develop their already extensive foreign and colonial business. Each of the Companies combined in Radiation Ltd. has had its own specialities; and it would be part of the policy to take advantage of the strength of the individual firms in respect of their particular specialities, so that, as the business in these specialities was developed, the valuable characteristics and qualities of each firm and its specialities would be conserved, but with the added benefit of the much greater resources rendered possible by combination.

PROSPECTIVE ECONOMIES.

After referring to various specialities of the different firms, he proceeded to explain how, in his judgment, the great economies to be effected by association might be expected to work-out in the case of Radiation Ltd., which, he said, was in the favourable position that a substantial proportion of its manufactures were articles which were indispensable in daily life. The various concerns had only to direct their strenuous endeavours, without thought of any sectional interests, to united and concentrated work for the promotion of the common advantage, in order to ensure that the future of Radiation Ltd. should be a most successful one. He had put efficiency and economy in the forefront as the qualities to be maintained in their apparatus; and he would add the resolve that this apparatus must be sold at prices as moderate as cost conditions would allow. Otherwise the result could only be restriction of the trade possibilities attainable. For the same reason the several combining concerns had in the past been very loth to increase their prices—recognizing that it was not in their own interest to do so beyond the unavoidable. The shareholders might take his assurance (which each of the Managing-Directors sitting by him could confirm from his personal knowledge) that every increase that had been made had not been imposed until it was long overdue, and that this prolonged delay in making advances after they were fully called for by the cost conditions had seriously affected the trading results of some of the Companies now in Radiation Ltd. When he told them that, for example, one advance in prices (not the first) having been made in June, 1918, no other was made until June, 1919, though during all this time the cost of labour was increasing by repeated specific awards, with the consequent result that all raw material prices were also increasing, they would realize that a serious sacrifice was made by the firms in holding-back the further advance as they did. What had been the increases during the war period in the cost of manufacture? Take just a few instances. Pig iron (a material which entered more largely than any other into the construction of their classes of goods) since 1914 had advanced 410 p.ct. This meant that the price was fully five times the pre-war figure; and they were advised that at no distant date its cost would be considerably more. Sheet-steel, which was also largely used, had advanced 474 p.ct.; the price being now nearly six times the immediately pre-war figure. Fire-clay materials had risen over 300 p.ct., or to a price fully four times the pre-war rate; and packing-cases had increased nearly 400 p.ct.—to a price close on five times the figure before the war. What were they going to do for the future? Costs were continually rising; and to meet this one expedient was to cut-down every expense to the utmost practicable limit, and aim at concentrating the manufacture of any one particular class of goods as far as possible in one works, so as to reduce the cost, while at the same time attaining a greater output, without increasing the labours of the workpeople. They were also, while giving the utmost encouragement to progress and individuality in the various companies, taking steps to maintain in a very high state of efficiency the general methods underlying the developments in any class of goods manufactured by the various Companies; and the improvements evolved from time to time would be embodied in the similar classes of apparatus made at each works. So that, apart from general design, apparatus made in the individual works would become standardized for all the works, every part being absolutely interchangeable throughout the similar types of apparatus made by all the combining Companies. This meant that gas undertakings could have a variety of designs, patterns, and makes in order to meet the tastes of their customers; and yet they would require only one stock of parts for renewals.



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To extend this system of standardization and interchangeability of parts to all the works of the Company was obviously an enormous undertaking, and must be a matter of time; but they were making steady progress, and before the year was out the gas industry would have a substantial earnest of what the Company had set themselves to do in this direction. No one not closely associated with a business of the class in which the Company were engaged, could form any idea of the great annual expenditure that had to be made in experimenting and research, and in making new patterns, tools, jigs, and plant for producing each new design or new type of apparatus. Without perfect reproducing plant, one could not have perfect fitting of parts; and without perfect fitting of parts, one could have no interchangeability. He was satisfied that it was only by such methods of production that, in face of the ever-increasing cost of wages and materials, their selling prices to the public could be prevented from advancing to a height most undesirable in all interests. With prices and wages continually soaring, it was obvious that one could not tell when, and to what extent, it might yet be necessary to increase the selling prices to meet the increasing costs. But the conditions of production which they were labouring to establish throughout all their works, were intended, and fitted, to ensure that, if it should prove that further advances must come, at the least they would be on a lower scale than would have been inevitable but for the economies in manufacture to which he had referred.

A Trying Year.

The past year had been a very trying and difficult one for all the Companies associated with Radiation Ltd. The output has been very considerably below the pre-war figure. They had had orders in abundance; and had they been able to cope with them, the public would not have had to suffer the inconvenience of going without those appliances which were so helpful in these days when economy of domestic labour and saving of fuel were so necessary, and those who had invested their money in the Company would have received the corresponding benefit. This Company had one special advantage. He had spoken of the fact that a large part of their income was derived from the manufacture of gas apparatus; but it had been the policy of the Companies forming Radiation Ltd. to acquire or become associated with other businesses, which, while not engaged in the gas industry, ran on parallel lines with it. This policy, which had already proved its value, had been yet further developed during the past year. It was the intention of the Directors to associate this Company with such businesses only as lent themselves by their nature to being allied with the Company's existing operations. The issued capital at Dec. 31 was £588,406 of preference capital and £1,043,864 of ordinary capital. Since the close of the year, the preference shareholders of the three original Companies had practically all exchanged into this Company; and the shareholders, both preference and ordinary, of Fletcher, Russell, & Co., Ltd., had done the same. And now the issued capital was approximately £2,251,700. Taking the figures as a whole, he thought the shareholders would agree that, in view of the difficult times, and all the special conditions of last year, they were very satisfactory.

Mr. H. M. Thornton seconded the motion, which was carried.

Final dividends of 3 p.ct. (less income-tax) on the preference shares and 3½ p.ct. (free of income-tax) on the ordinary shares were then declared.

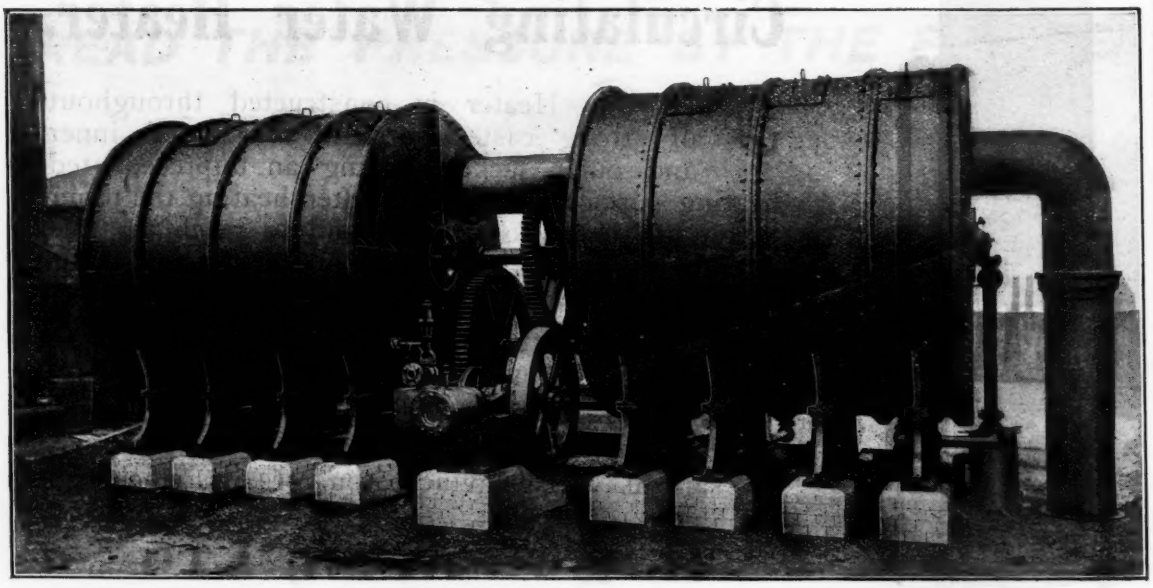
GAS WORKERS TO BALLOT.

The National Federation of General Workers last Wednesday received the replies from the Executives of the eight unions concerned in the gas-workers' dispute, on the proposal to take a ballot to decide whether notices shall be tendered to enforce the claims set forth on p. 214 of last week's "Journal." All the unions intimated that they agreed to a ballot. The unions interested are: Amalgamated Society of Gas, Municipal, and General Workers; Dock, Wharf, and Riverside and General Workers' Union; National Amalgamated Union of Labour; National Union of General Workers; National Amalgamated Union of Enginemen, Firemen, Mechanics, Motormen, and Electrical Workers; National Amalgamated Labourers' Union; the Workers' Union; and Municipal Employees' Association.

The Executive of the Federation met last Thursday, under the chairmanship of Mr. J. R. Clynes, M.P., to complete the arrangements for the ballot. It was decided that the papers should be made returnable to the Federation by May 18. The Executive will meet on the following day to consider the result and take the necessary action. The papers will contain a statement of the issue setting forth the claims and the employers' reply; and the men will be asked to state "Yes" or "No" on the question whether they are in favour of tendering notices to cease work. In the event of the ballot showing a majority for a strike, the Executive will arrange for notices to be given on a general date at all the undertakings involved. There are varying agreements as to the length of notice; but it is expected that a fortnight will cover them all, so that if a strike takes place it would not operate much before the end of May. It is hoped that negotiations will be reopened and an agreement reached without a strike; but the Federation Executive say they are fully prepared to face the issue, if necessary, as they regard their claim as a reasonable one.

There was a discussion at the Lancaster Town Council last Wednesday, on a further recommendation that the Gas Commissioners be authorized to join the Sulphate of Ammonia Association. There was strong opposition shown. The Manager (Mr. G. Dixon) said he had gone carefully into the matter, and advised them to become members. A month ago 84 p.ct. of the private and public gas undertakings had joined; and the number had increased since. By thirteen votes to eleven, the minutes were adopted.

ROTARY SCRUBBER WASHERS



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CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *May* 3.

In the London tar products market pitch maintains its firm tone. Shipments for the current season continue, and there are many inquiries for next season's delivery. Makers, however, are rather loth to sell far forward at the present time, preferring to wait and see how the market develops. Creosote is firm at about 1s. 1d. to 1s. 1½d. per gallon net in bulk. Tar spirits continue in request. Solvent naphtha is about 3s. 3d. to 3s. 6d. per gallon. Naphthalenes are in strong demand. Crude carbolic acid, 60's, is about 4s. per gallon.

In sulphate of ammonia the position remains unchanged.

Tar Products in the Provinces.

May 3.

The average values for gas-works products during the week were: Gas-works coal tar, 82s. 6d. to 87s. 6d. Pitch, East Coast, 122s. 6d. to 130s. per ton f.a.s.; West Coast—Manchester, 120s. to 125s.; Liverpool, 120s. to 125s.; Clyde, 125s. to 130s. nominal. Benzol 90 p.ct. North, 2s. 3d. to 2s. 4d.; crude 65 p.ct. at 120° C., 1s. 5d. to 1s. 7d. naked at makers' works; 50-90 p.ct. naked, North, 2s. 2d. to 2s. 4d. Toluol, naked, North, 2s. 6d. to 2s. 7d. nominal. Coal tar crude naphtha in bulk, North, 11½d. to 1s. Solvent naphtha, naked, North, 3s. 3d. to 3s. 4d. Heavy naphtha, North, 3s. 4d. to 3s. 6d. Creosote, in bulk, North, liquid, 11½d. to 11½d.; salty, 7d. to 7½d. Heavy oils, in bulk, North, 11½d. to 1s. Carbolic acid, 60 p.ct., 3s. 11d. to 4s. Naphthalene, £30 to £35; salts, £8 10s. to £9 10s., bags included. Anthracene, "A" quality, 8d. to 9d. per minimum 40 p.ct.; "B" quality, nominal.

FROM A MARKET CORRESPONDENT.

Tar Products.

Markets do not exhibit any particular change; and a firm tone prevails generally. Pitch is still in great request at full rates, and buyers are keen on covering their needs up to the end of the year. The East Coast reports sales at £7 10s.; and over £7 has been paid in the Manchester district. The future is decidedly uncertain; the market is very high, and many people would prefer to sell than to hold. The shipping season is now ending; but the South Wales demand for briquette-making purposes is bound to be heavy while fuel remains so dear. Creosote is scarce, and prices are well supported. Benzol is much wanted; and stocks are none too plentiful anywhere. Carbolic acid is much as it was. The usual channels are refused licences to export crystal; but it leaves the country nevertheless. Cresylic acid is firm at late rates. There is very little business that matters in solvent naphtha, and the market is on the weak side. Naphthalenes are scarce; sales of refined being reported at £40. Even inferior sorts make £30. The export trade and the dye trade are the factors that count here. Crudes also are strong. Intermediate products are practically unaltered; the small imports from America having had no effect on the position.

Latest quotations are as follows:

Benzol: 90% London 2s. 4d. to 2s. 5d., North 2s. 3d. to 2s. 4d.; 50-90% 2s. 2d. to 2s. 3d. London, 2s. 1d. to 2s. 2d. North; crude 60-65%, 1s. 5d. to 1s. 7d.; pure, 3s. per gallon naked.

Crude Tar: London, 72s. 6d. to 77s. 6d.; Midlands, 70s. to 72s. 6d.; North, 70s. to 75s. per ton *ex* works. Refined tar, 50s. per barrel (free) on rail.

Pitch: London, 150s. per ton; East Coast, 140s. to 150s. per ton; West Coast, 135s. to 150s., with Manchester 140s. per ton, and Glasgow 140s. per ton; South Wales, 140s. per ton.

Solvent Naphtha: London, 3s. 4d. Provinces average 3s. 2d. per gallon.

Crude Naphtha: Naked, 10d.; North, 9d. per gallon.

Heavy Naphtha: 3s. 2d. per gallon.

Naphthalene: Refined, £40 per ton nominal; inferior, £30; crude, £9 10s. to £18, according to quality.

Toluol: Naked, 2s. 9d. per gallon nominal. North, 2s. 7d. Pure, 3s.

Creosote: London, 1s. 0½d. to 1s. 1d.; North, 1s.; heavy oil, 10½d. per gallon in bulk.

Anthracene: 40-45%, 9d. per unit per cwt.

Grease Oils: 18° Tw. (naked), £6 10s. per ton f.o.r. makers' works.

Aniline Oil: 1s. 5d. to 1s. 6d. per lb., drums extra.

Aniline Salts: 1s. 10d. to 2s. per lb.

Cresylic Acid: 95%, 4s. 3d. to 4s. 6d.; 97-99%, 4s. 6d. to 4s. 9d. per gallon *ex* works London, f.o.b. other ports.

Carbolic Acid: Crude 60%, 4s. per gallon; crystals 40%, 1s. 3d. to 1s. 4d. per lb.

Salicylic Acid: Technical, 3s. 6d. to 3s. 9d.; B.P., 3s. 9d. per lb.

Sulphate of Ammonia.

The home trade continues very active, and prospects for export business after the end of the current month are regarded hopefully, although a modified form of control is being looked for. As regards next season, it is early to prognosticate; but a small increase in prices to agricultural users would not be surprising. On the Pacific Coast of America there are no stocks available, and very high prices are quoted for future delivery.

The Kirriemuir Town Council have decided to instal the "A. & M." patent pressure-wave automatic controllers to the whole of their public gas-lamps, numbering about 200.

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Has all the advantages and improvements of the larger ordinary "Eureka" Cooker, and is specially adapted for use where space is limited. The Cooker is raised on legs seven inches from the ground, and stooping is thereby minimised when using the oven. The Oven is porcelain-enamelled inside and out to admit of easy cleaning. The "Lewis" Patent Plate Rack and Back-Plate is fitted, which utilises spare room and heat, saving time and labour.

JOHN WRIGHT & CO.,
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BIRMINGHAM.

Scunthorpe Gas Scheme.

The application of the Scunthorpe and Frodingham Urban District Council for sanction to borrow £200,000 for the erection of new gas-works, formed the subject of an inquiry last week by Mr. R. G. Hetherington, on behalf of the Ministry of Health. Mr. G. E. Davy (Clerk to the Council) said that about 1913 it became apparent to the Council that the demand for gas would very shortly tax the capacity of the works; and they decided to purchase a new site. Permission was given for a loan of £66,000; and there was no doubt that some scheme would have been proceeded with but for the war, which caused the matter to be dropped for the time being. It was estimated that at least 3500 additional houses were required as soon as they could be built. This was being partially met by housing schemes promoted by the Council and various public utility societies. The present works were capable of producing 240,000 c.ft. per 24 hours; and this could be augmented by 150,000 c.ft. from the water-gas plant for the same period. Last winter, in spite of limitations, as much as 403,000 c.ft. of gas were supplied during 24 hours; but that was quite inadequate to meet the demands; and it was at a time when street lighting was reduced to the minimum. The Inspector carefully considered the plans prepared by Mr. S. Moore (the Gas Engineer), and later visited the existing works, and also the site for the proposed new works.

The Coal Shortage in Ireland.—Gas company officials participated in a conference of various interests in Ireland affected by the continuance of the coal shortage, blame for which is cast on the Ministry of Shipping, who, it is contended, ought to provide more boats for transit from across-Channel. Urgent representations were made by the conference to the Coal Controller for Ireland (Mr. Morrison); and he has made strong representations to the Shipping Ministry and to the Coal Controller in London. Lighting supplies and manufacturing industries are threatened with stoppage in many instances, if the situation is not quickly relieved.

Wages of Meter Inspectors at Liverpool.—The Industrial Committee have decided that meter inspectors in the employ of the Liverpool Gas Company were included in the award of the Court made last January. The parties to the award referred to were the National Federation of General Workers and the Federation of Gas Employers. The claim then submitted for determination was for increases of wages to general workers employed in connection with undertakings—namely (1) 10s. a week or 1s. 8d. a day or shift for adults; (2) 5s. a week or 10d. a day or shift for juniors. It was stated on behalf of the Federation of General Workers that their members employed by the Liverpool Gas Company as meter inspectors had hitherto received all the advances granted to gas workers, including a sum in lieu of the bonus of 12½ p.ct. For the Company, it was stated that meter inspectors were recognized as part of the Company's permanent administrative staff. They had never regarded them as included in the wages awards; and any advance which had been granted was *ex gratia*.

British Gas Light Company's Potteries Works.

At a meeting of the Stoke-on-Trent Town Council last Thursday, the Gas Committee recommended that the Council should proceed to obtain compulsory powers to acquire the local gas undertaking of the British Gas Light Company, and that the Town Clerk be authorized to take the necessary steps in the matter. Alderman A. Brockhouse (the Chairman of the Gas Committee) said that in March of last year the Council accepted and confirmed a scheme of the Engineer, for the centralization of the gas supply, by the unification of the four Corporation undertakings, and the purchase of the British Gas Light Company's works. The demand for gas from the Corporation works was going up by leaps and bounds, both inside and outside their area; and it was necessary that they should make provision for the increased calls which would be made upon them by the winter of 1921. Alderman Goddard thought it would be very unwise to come to any conclusion on the matter until, in committee, they had had the opportunity of cross-examining the Gas Engineer, and of being made acquainted with all the details of his scheme. He pressed this point, and remarked that they had no figures before them. The Mayor (Alderman W. E. Robinson) said the Council adopted the principle of purchase, and gave authority to open negotiations with the Company. As the Company refused, they were now recommended to ask for compulsory powers; but he did not desire a vote, until members were in possession of the facts. A resolution was eventually carried, to the effect that the scheme should be considered by the Council in committee within fourteen days.

Fatality at Heckmondwike.—While three men were removing a metal mouthpiece, weighing 7½ cwt., from a retort at the works of the Heckmondwike and Liversedge Gas Company, the mouthpiece crashed through a cast-iron floor-plate, and one of the men, Norman Cawthra, fell headlong after it, a distance of 10 ft., with the unfortunate result that his spine was fractured, and he died in the Dewsbury Infirmary. A verdict of "Accidental death" was recorded at the inquest.

Good Results at Spenborough's Gas-Works.—At the meeting of the Spenborough Urban District Council at which a Chairman for the ensuing year was elected, Mr. Law (the retiring Chairman) said that had Mr. Collier (the Chairman of the Gas Committee) been present, he had intended expressing the Gas Committee's thanks to the Engineer (Mr. A. L. Jennings) and his staff for the excellent results which had been achieved in the production of gas for the last seventeen months. This appreciation included the whole of the workers, from the highest to the lowest, because they were assured that, as far as possible, there had been perfect harmony at the works, largely due to the good understanding between the Engineer and the staff generally. Mr. Taylor endorsed this expression. Mr. Grylls thought it was the best announcement he had heard submitted to the Council. If they could get this spirit of co-operation in all departments, it would be a happy augury for the future prosperity of the undertaking.

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Stretford Gas-Works Purchase Proposal.—With reference to the negotiations between the Manchester Corporation and the Stretford Gas Company for the transfer of the undertaking to the city, it is reported that the Stretford Urban District Council have decided to oppose the proposed sale. They state that the negotiations were opened without their knowledge, and that if they co-operate with Manchester in the control of such an important communal service, it must be on the basis of the Stretford Council having proprietary control of property within their own area.

Preference for Gas at Airdrie.—Sixteen new dwelling-houses, erected by the Town Council of Airdrie under the housing scheme for the burgh, which were formally opened last Saturday week by Sir George Macrae (the Chairman of the Scottish Board of Health), are fitted throughout with gas for both lighting and cooking; and the Corporation have supplied each house with a cooker free of rental. A special main is laid to them from the gas-works. They are the first instalment of 400 houses being erected by the Council under the rate-aided scheme; and it is intended that gas-fittings shall be provided in all the other houses.

Bombay Gas Company, Ltd.—At the meeting on the 13th inst., when the accounts for the twelve months ended Dec. 31 will be submitted, the Directors will report that the profit for the year, as shown by the net revenue account, after allowing for interest and exchange, amounts to £31,660, making, with £23,534 brought forward from the preceding year, £55,194 available for dividend. Deducting the interim dividend (£11,200), and placing £1374 to the reserve, £5614 to the renewal fund, and £153 to the insurance fund, there was £36,852, out of which the Directors recommend a dividend of 4 p.ct. (less income-tax), making 8 p.ct. for the year, which will leave £25,652 to be carried forward. The Directors much regret to report the death of their esteemed colleague, Field-Marshal Sir Evelyn Wood, V.C., G.C.B. They desire to place on record their admiration of his high character, and their appreciation of the valuable services which he rendered to the Company as a Director for a period of fifteen years. A resolution will be submitted at an extraordinary general meeting for the adoption of modern Articles of Association of the Company in substitution for the existing articles, which have not been materially altered since the incorporation of the Company more than fifty years ago.

STOCK MARKET REPORT.

THE Stock Exchange has just concluded the most disagreeable week that it has had for many a long day. Briefly stated, reckless and excessive gambling in speculative commodities has brought the adventurers to grief; and some forced realizations at slaughter-house prices have given markets a nasty jar. It is hoped, however, that the clearing of the atmosphere has fairly progressed, and certainly before Friday ended the general feeling was more comfortable.

In the gilt-edged market, Home Government issues opened well and made some very nice advances; but by Wednesday they were going the other way. War Loan was the weakest, and touched 83½—a record. Friday's finals were: Consols 46⅜ 47⅛, War Loan 83½ 83¼, Funding 68⅜-70, Victory 76⅜-78. Home Rails moved irregularly, but not much at any time. Canadians were rather better; but Argentines were weak.

In the Foreign Market, French were moderate, Belgian and Brazilian firm, and Russians very cheap. The Miscellaneous Market was the centre of liquidation; and Oil was certainly the bull's-eye. Rubber was a good deal depressed.

Business in the Gas Market was more lively and more abundant—thanks mainly to a noteworthy recovery in Imperial Continental, based on great expectations. On Monday, it was done at 116, on Tuesday at 130, and on Wednesday at 132; the quotation showing a jump of 12 points. This was the only bright spot; sellers of everything else having to take lower figures, as in the other markets. Consequently they were not too pressing to realize. Some issues of the London Companies were put down. Primitiva preference was lower.

Bargains done for cash during the week were as follows: On Monday, European 7, Gas Light ordinary 48¼, 48½, 49, Imperial Continental 116, 118, 118½, 119, Primitiva 23s., 24s., ditto preference 45s., ditto debenture (1911) 47⅞, 48¼. South Metropolitan 49¼. On Tuesday, European 7, Gas Light ordinary 48¼, Imperial Continental 125, 127, 129½, 130, Primitiva 25s., South Metropolitan 48⅞, 49½. On Wednesday, Cape Town 7⅜, 7½, European 6⅞, 7 3/32, Gas Light ordinary 49, 49⅛. 49¼, ditto debenture 47¼, Imperial Continental 129, 129½, 130, 131, 131½, 132, Primitiva 22s. 6d., ditto preference 42s. 6d., South Metropolitan 49¼, South Suburban 65, ditto debenture 75, Wandsworth "B" 55, ditto debenture 45. On Thursday, Bournemouth 10 p.ct. 8 5/16, Cape Town 7⅜, 7½, Gas Light ordinary 47, 48, 48¼, 48⅛, 48 13/16, 49, 49⅛, ditto preference 56½, 57, 57¼, 58, ditto debenture 47, Imperial Continental 130, 130½, 131, 131⅜, 132, South Metropolitan 48¼, 48⅜, Tottenham "B" 45½. On Friday, Bournemouth 10 p.ct. 8 5/16, European 6½, Gas Light ordinary 48, 48¼, 48⅜, 49, Imperial Continental 127, 128, 129, 130, Primitiva preference 40s. 4½s. 3d., South Metropolitan 49, 49½, Tottenham "B" 45½.

In the Money Market, there was a steady, but not immediate, demand, which was met without difficulty. Discount rates remained firm. Silver had a fall to 63⅜d. The Bank rate is 7 p.ct., as fixed on April 15 last.

Mr. A. Marks has been appointed representative for Messrs. Albert Lee & Co., Ltd., in the Southern and Eastern Counties, in place of Mr. W. P. Kerr, who has been transferred as the firm's representative for the North of England.

ANTE-WAR PRICES AND DIVIDENDS, LATEST DIVIDENDS, AND LAST WEEK'S BARGAINS.

Issue. £	Shares.	When Ex-Dividend.	Ante-War Dividend & Bonus. p.c.	Last Dividend.	NAME	Closing Prices, July 28, 1914.	Present Prices	Lowest and Highest Prices of Bargains.
183,049	Stk	Mar. 11	4	4%	Aldershot 4 p.c. Pref.	..	58—63	..
1,551,868	,,	Mar. 26	3½	3 5/8%	Alliance & Dublin Ord.	83—84	37—42	..
374,000	,,	Jan. 15	4	4%	Do. 4 p.c. Deb.	76—79	61—63	..
280,800	5	Oct. 30	3½	3%	Bombay, Ltd.	5⅞—6⅛	5—6½	..
60,000	10	Feb. 26	16	10%	Bournemouth Gas and Water { 10 p.c.	20—30	8½—9	8 5/16—8 11/16
238,110	10	,,	7	7%	B 7 p.c.	15—15½	9—10	..
115,800	10	,,	6	6%	Pref. 6 p.c.	13½—14	8½—9	..
162,065	—	Dec. 30	—	4%	4 p.c. Deb.	..	64—66	..
993,045	Stk.	Feb. 12	14	30/-	Brentford A Consolid.	261—266	45—50	..
734,930	,,	,,	11	26/8	Do. B New	204—209	40—45	..
58,600	,,	,,	8	8%	Do. 5 p.c. Pref.	109—113	70—75	..
221,400	,,	Dec. 11	4	4%	Do. 4 p.c. Deb.	91—93	64—66	..
214,775	,,	Mar. 11	11	7 1/2%	Brighton & Hove Orig.	208—218	121—126	..
244,300	,,	,,	8	5 1/2%	Do. A Ord. Stk.	154—159	80—85	..
1,287,500	Stk.	Feb. 26	5	5%	Bristol 5 p.c. max.	..	..	..
580,000	20	Apl. 14	13½	10%	British	44—45	24—26*	..
120,000	Stk.	Dec. 30	4	4%	Do. 4 p.c. Deb. Stk.	88—90	59—61	..
245,771	,,	,,	4	4%	Buenos Aires 4 p.c. Deb.	86—87	47—50	..
100,000	10	—	—	—	Cape Town & Dis., Ltd.	1½—2½	7½—7½	7½—8½
180,000	10	Oct. 30	—	4½%	Do. 4½ p.c. Pref.	4—6	6½—6½	..
100,000	Stk.	Dec. 30	4½	4½%	Do. 4½ p.c. Deb. Stk.	73—75	58—63	..
157,158	,,	Feb. 26	5	5%	Chester 5 p.c. Ord.	108—110	..	..
1,512,280	,,	Feb. 26	5/5/4	33/4	Commercial 4 p.c. Stk.	106—108	48 53	..
260,000	,,	,,	5½	26/8	Do. 3½ p.c. do.	103—105	44—47	..
475,000	,,	Dec. 11	8	8%	Do. 3 p.c. Deb. Stk.	69½—71½	46—49	..
200,000	,,	,,	4	—	Continental Union Ltd.	76—79	27—32	..
200,000	,,	,,	7	—	Do. 7 p.c. Pref.	115—118	40—60	..
61,600	Stk.	Feb. 26	14½	10 4/9%	Croydon A 10 p.c.	..	130—140	..
278,400	—	,,	11½	7 13/16%	Croydon B and C 7 p.c.	..	90—100	..
492,272	Stk.	,,	6	5%	Derby Con. Stk.	123—125	..	..
55,000	,,	—	4	4%	Do. Deb. Stk.	102—104	..	..
1,002,180	10	Jan. 29	10	5/6	European, Ltd.	17½—18	6½—7½	6½—7 1/16
16,298,975	Stk.	Feb. 12	4/11/4	30/-	Gas { 4 p.c. Ord.	98—102	47—50	47—49½
2,600,000	,,	,,	8½	26/8	Light { 8½ p.c. max.	76—79	38—43	..
4,082,985	,,	,,	4	4%	& { 4 p.c. Con. Pref.	96—99	55—58	56½—58
4,674,850	,,	Dec. 11	8	8%	Coke { 3 p.c. Con. Deb.	72½—74½	47—49	47—47½
130,000	,,	,,	10	10%	10 p.c. Bonds	..	..	..
82,500	,,	Mar. 11	6	8 2/3%	Hastings & St. L. 5 p.c.	..	55—60	..
258,740	,,	,,	8½	2 1/3%	Do. 8½ p.c	27—30	33—43	..
70,000	10	Apl. 28	11	7%	Hongkong & China, Ltd.	15½—16½	8½—9½	..
86,608	Stk.	Mar. 11	9	6 3/4%	Hornsey 7 p.c.	..	88—98	..
121,000	,,	,,	7½	5 5/8%	Ilford A and C.	151—154	86—91	..
65,750	,,	,,	8½	4 1/2%	Do. B	115—118	65—70	..
65,500	,,	Dec. 30	4	4%	Do. 4 p.c. Deb.	92—94	67—70	..
4,940,000	,,	May 14	9	4 1/2%	Imperial Continental	156—160	127—132	116—132
1,235,000	,,	Feb. 12	3½	3 1/2%	Do. 3½ p.c. Deb. Red.	84—86	80—86	..
135,343	,,	Mar. 26	4½	3 1/3%	Lea Bridge Ord. 5 p.c.	119—121	80 85	..
1,498,995	,,	Feb. 26	10	37/6	Liverpool 5 p.c. Ord. { A / B	211—213 / 146—148	..	..
806,068	,,	June 30	4	4%	Do. 4 p.c. Pr. Deb. Stk.	..	..	..
165,736	,,	Feb. 26	7/5/6	33 1/3%	Maidstone 5 p.c.	..	52 57	..
75,000	5	June 11	5	5%	Malta & Mediterranean Met. of Melbourne { 4½ p.c. Deb	4½—4¾ / 99—101	12—2½ / 89—16	..
250,000	100	Apl. 1	4½	4 1/2%	Monte Video, Ltd.	11½—12	73—77	..
541,220	Stk.	Nov. 27	4	5%	Newcastle&Gateh'd Con.	96½—99½	63—65	..
1,075,552	,,	Feb. 26	4½	3 1/3%	Do. 3½ p.c. Deb.	86—88	55—57	..
339,706	,,	Dec. 30	3½	3 1/2%	North Middlesex 10 p.c.	..	18—19½	..
15,000	10	Mar. 11	—	8 3/3%	,, ,, 7 p.c.	14—15	8½—9½	..
65,940	10	,,	7/14/0	6 1/2%	Oriental, Ltd.	117—122	108—106	..
800,000	Stk.	Nov. 27	5	5%	Ottoman, Ltd.	7½—7¾	4½—5½	..
60,000	5	Mar. 26	10	1/-	Portsea, Island B	128—131	66—91	..
68,000	50	Mar. 11	18	7 1/2%	Do. C	118—121	68—68	..
100,000	50	,,	13	6 1/2%	Primitiva Ord.	5½—6	1—1½	27/6—25/-
349,988	5	April 29	8	—	Do. 5 p.c. Pref.	4½—5	2—2½	40/-—45/-
499,966	5	June 26	5	—	Do. 4 p.c. Deb.	91—98	70—72	..
931,500	100	Dec. 1	4	4%	Do. ,, ,, 1911	..	47—50	47½—48½
600,000	Stk.	Jan. 29	4	4%	River Plate 4 p.c. Deb.	86—87	47—50	..
848,198	,,	Dec. 30	4	4%	San Paulo { 6 p.c. Pref.	10½—11	71—72	..
158,000	10	Mar. 26	6	8/-	{ 5 p.c. Deb.	41—49	39—41	..
126,000	50	Dec. 30	5	5%	Sheffield A	235—254	68—73	..
186,000	Stk.	Mar. 11	10	50/-	Do. B	223—224	68—68	..
209,984	,,	,,	10	41 2/3	Do. C	220—222	58—63	..
528,500	,,	,,	10	35/5	Shrewsbury 5 p.c.	..	..	..
133,201	Stk.	Sept. 13	4	4%	South African	110—111	13—13	..
90,000	10	Oct. 15	9	10%	South Met. 4 p.c. Ord.	111—113	47—50	46½—49½
5,609,695	Stk.	Feb. 12	5/4/0	30/-	Do. Pref.	..	93—95	..
250,000	,,	Jan. 15	—	5%	Do. 3 p.c. Deb.	73½—74½	47 50	..
1,896,445	,,	,,	3	3%	South Shields Con. Stk.	107—109	103—104	..
234,620	,,	Feb. 26	3½	3%	S'th Suburb'n Ord. 5 p.c.	114—116	64—69	64
1,087,795	,,	Aug. 14	6	3 1/3%	Do. 5 p.c. Deb. Stk.	116—118	78—83	76
247,558	Stk.	Dec. 30	5	5%	Southampton Ord.	99—102	60—63	..
547,740	,,	Nov. 13	7½	8 1/3%	Do. 4 p.c. Deb. Stk.	..	61—68	..
121,275	,,	Dec. 30	4	4%	Tottenham { A 5 p.c.	185—188	65—70	..
120,000	,,	Aug. 14	—	3 1/3%	{ B 3½ p.c.	115—117	45—50	45½
762,275	,,	,,	6	2 1/2%	District { 4 p.c. Deb.	87—89	61—64	..
181,255	,,	Dec. 11	4	4%	Tuscan, Ltd.	5—6	1—2	..
182,880	10	Dec. 30	5	—	Do. 5 p.c. Deb. Red.	98—95	45—50	..
149,900	10	July 1	5	5%	Tynemouth 5 p.c. max.	108½—109	72—74	..
326,478	Stk.	Mar. 11	5	3 1/3%	Wandsworth, Wimbledon, and Epsom—			
80,000	,,	Feb. 26	3½	35/-	Wandsworth A 5 p.c.	151—156	83—88	..
256,688	,,	,,	6½	40/-	Do. B 3½ p.c.	129—134	61—66	55
108,075	,,	,,	—	33/6	Do. C	..	61—66	..
140,865	,,	,,	—	33/6	New Ordinary	..	61—66	..
353,000	,,	,,	5½	33/9	Wimbledon 5 p.c.	117—122	63—68	..
96,000	,,	,,	6½	40/-	Epsom 5 p.c.	121—126	63—68	..
88,416	,,	Dec. 30	5	5%	3 p.c. Deb. Stk.	47—50	43—50	45

* Ex Div.

Budleigh Salterton Gas Company.—At the annual meeting of the Budleigh Salterton Gas Company, the Chairman (Mr. S. Simpson) referred to the valuable services rendered to the Company by the late Chairman (Mr. A. R. Steele Perkins), and stated that the present favourable position of the Company was due to his unfailing efforts. As to the year's working, the present selling price (with the 6d. per 1000 c.ft. rebate)—viz., 4s. 6d. per 1000 c.ft.—was a record for any similar sized undertaking in the country. This was achieved by the manufacture of gas in a plant recently patented by the Secretary and Manager (Mr. J. W. Gibson); and he understood the plant was being adopted in other towns at home and abroad. Without this plant, the Company would have had to increase the price of gas considerably. A dividend of 7 p.ct. on the ordinary shares was declared. [The apparatus to which the Chairman referred as having been so beneficial to the Company is the "Simplex" water-gas plant, invented by Mr. Gibson, the exploitation of which has recently been taken up by the Vertical Gas-Retort Syndicate, Ltd., of No. 17, Victoria Street, S.W. —see "Journal," Dec. 9 last, p. 543.—Ed. "G.J."]

Mr. Forrester Clayton, J.P., Managing-Director of Messrs. Thomas Clayton (Oldbury), Ltd., has been elected an Alderman of the County of Middlesex.

The Darwen Corporation propose to transfer £1000 from the Gas Department to the water-works accounts, in order to adjust an adverse balance on the latter.

The Housing Committee of the Chesterfield Corporation have received estimates for the supply of gas and electric services to the new municipal houses on the Boythorpe site; but they have decided to lay on only the gas. The cost of the extension of electric cables would be £5528.

Messrs. A. and W. Richards, of No. 37, Walbrook, E.C., on the instructions of the Directors of the Brighton and Hove General Gas Company, are offering at par £19,700 of 7 p.ct. debenture stock, to be redeemed at par on June 30, 1930. The whole of the interest forms a first charge on the net revenue of the Company, and on last year's figures is covered six times over. The stock will be allotted in priority of application.

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